THE

ELECTRICAL REVIEW.

VOL. LXVII. SEPTEMBER 23, 1910. No. 1,713.

ELECTRICAL REVIEW.

Vol. LXVII.] CONTENTS: September 23, 1910. [No. 1,713.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

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OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.

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CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1910 EDITION

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London E.C.

BRITISH AND AMERICAN TRAMWAYS.

THE publication of statistics relating to American tramways has moved a financial contemporary to compare the condition of tramway enterprise in this country with that of the United States.

It is obviously easy to make comparisons, but the difficulty is to draw clear and trustworthy conclusions regarding them The figures revealed by the American census show that at the end of the year 1907 the United States possessed 1,236 tramway systems, while the total number of lines in operation in the United Kingdom amounted to 305. With such a large difference in the number of systems in operation one is not surprised to learn that the capital account of the American systems is more than ten times that of the English, and the income about seven times greater.

To set up a number of comparisons between the number of passengers carried and the profits earned is not of much value, however, on account of the extremely differing conditions which exist in the two countries.

Primarily the attitude of the public of the two countries towards tramways is widely different. It has to be remembered that in England the tramways have in many cases come into existence after the development of the district, whereas in the United States the tramways to a great extent have been the means of opening up and developing populous districts. In addition to there being less flexibility in the conditions obtaining in this country, there already existed a means of transit which, while inefficient, was nevertheless an influential factor in retarding the development of tramway enterprise.

It became customary in the United States, when opening up townships or estates, to construct first of all a tramway line, the theory being that the populace would follow the system, but this, while being a root idea in the development of the American tramways, has had no corresponding influence in the United Kingdom.

It is true that when electric tramways were being introduced some 15 years ago, it was thought they would assist in the development of the suburbs, but while, to some extent, this has been realised, it is generally admitted that it has proved somewhat of a failure. It is not difficult, of course, to point to instances where a neighbourhood has been, to some extent, helped; but, on the other hand, one could point to many miles of tramways constructed in accordance with this idea, but which are on those particular sections hopeless failures from a financial point of view.

This peculiar phase of tramway enterprise in the United Kingdom demonstrates the difficulty of forecasting with any degree of accuracy the traffic possibilities of a given district, while our American friends have been more or less able to realise their expectations of traffic. Even in London, with a constant stream of people in all directions, there have been

some remarkable results; comparatively congested neighbourhoods have given in some cases but poor returns, while apparently unpromising districts have quite falsified expectations.

In comparing the tramways of the United States with this country, one has further to remember that we have here developed on rather distinct lines. For the most part, tramways are owned and operated by municipalities, and whatever views one may hold on the general question of the merits of private and municipal ownership, one has certainly to admit that municipal systems have been distinctly limited in the areas over which they can operate.

A notable example is that of Birmingham, the tramway systems of which have been in every sense a conspicuous success, but have been nevertheless seriously cramped by the limitations of area over which either the municipal or the company lines could be operated.

These are some of the factors which are indigenous to the country, but there are other matters which have seriously retarded tramway development.

We are saying nothing new when we point out that the initial cost of electric tramways has proved in many places prohibitive; for while one naturally expects a high standard of construction in the centre of towns and cities, it is inconceivable that throughout the suburbs and country districts the same regard should be paid to the details of the system. At the same time, one has to bear in mind that in this country the roads are for the most part of a first-class character, and with the introduction of the tramways on their surface, it was obvious that special restrictions would be enforced in regard to the permanent way; but while it has been desirable to maintain the surface of the road in good order, it was hardly necessary to go to the extravagant lengths that one has seen in tramway systems outside the London area. For instance, to carry wood-paving through country lanes and suburban roads is a form of expenditure which is wholly unnecessary, and has an important influence on the earnings.

It is clear that the standard of construction in this country was bound to be a good deal higher than was considered necessary in the United States, where the roads are not particularly good, and the inhabitants are inclined to put up with a more flimsy overhead construction than would pass muster in this country.

It is interesting to recall here that dollars were lost by the million on early trolley line systems in the States. It is generally admitted that their loss, and our delay, was in some respects our gain.

Mr. S. Sellon, in the course of the discussion at Dublin on Railless Traction in June last, said that the fact that some tramways and light railways had not returned very generous dividends to their shareholders, or satisfactory results to the ratepayers, was not due to any other cause than to over-capitalisation as well as wasteful and extravagant expenditure. There were a number of tramways which "would to-day be an unqualified success if the capital employed for the purpose had been spent in a legitimate manner instead of swelling the pockets of promoters, and unjustifiable demands of local authorities."

Another influence which has operated against the success of British tramways has been the exceedingly low fares. We are quite aware that owing to the comparatively low railway fares, it was necessary, in order to attract the public, that tramway charges should be on a moderate basis, but we think, in many cases, they are absurdly low, and there have been far too many concessions granted to particular classes of the community.

As was pointed out by Alderman Flint in his paper read at the Municipal Tramway Conference this week, it has become very necessary to watch carefully the demands made by municipal tramway employés, who, as Mr. Spencer in his presidential address reminds us, now number about 60,000.

Halfpenny fares, as a consequence of success in one town, have been repeated in other places in the most reckless manner, the consequence being that some tramway concerns have not only never been in a position to show an adequate return on the capital expenditure, but we are afraid that they have not been able to meet depreciation and renewal charges in a very satisfactory manner.

Power from Wind and Solar Heat.

The scheme for harnessing the wind and utilising solar radiation for producing energy for industrial purposes, which Prof. Fessenden brought forward at the B.A., is interesting. We give elsewhere in this issue the figures on which Prof. Fessenden bases his statement that energy so produced can be stored and distributed for industrial purposes more cheaply than energy produced as required by steam or gas engines. The scheme is, we understand, to be tried on a large scale in the States, at a place where coal is dear and the solar radiation unusually high. The practical experience now to be obtained will be more valuable than anything else in proving what can be done, and the reliability of large windmills and solar-radiation boilers. In the meantime, the difficulties due to the intermittent nature of these sources of power seem to us to be large. As an example, the mean horse-power to be derived from the solar-heat tank about to be constructed is given as 800 KW., but the discussion showed that when the sun was most powerful 30,000 H.P. could be obtained. We are not informed what the maximum capacity of the steam turbine (which is to take steam from the tank at atmospheric pressure) is to be, but it seems to us that the estimated capital cost of the plant is low. Again, it is not improbable that in such hot climates the circulating water for the condensers for the turbine may be difficult to obtain in sufficient quantities at low temperature. In any case, the steam turbine will be worked on widely-varying loads, and must be uneconomical at the extreme points of the range. Turning to the wind power, the same variation in available power has to be met, and the maximum load obtained from the wind must be many times greater than the mean load distributed from the station. The windmill and the pumps connected to it have to be designed to deal with this high maximum, and the factors of safety must be large enough to prevent the mill being destroyed by a hurricane. Bringing the matter down to central-station practice, we admit that the coal bill is wiped out when wind and sun are harnessed. On the other hand, the power factor of the generating station is miserably low, and hence capital costs must be high. It remains for Prof. Fessenden to justify his capital costs from actual experience; even then we should want to see his repair bill before endorsing his statement that windmills round our coast will render the Carville power station obsolete.

The Coasting Clock.

Short reference was made in a recent issue of the Electrical Review to the paper read by Mr. Putnam before the Am.I.E.E. at their last annual convention, but the matter is likely to be of such importance, as a factor in the economical operation of our electric railways and tramways, that we have abstracted the paper for the benefit of our readers.

Any apparatus which can lead directly to a saving of 24 per cent. in power consumption is worth a few minutes' consideration. One of the eminent speakers pointed out, in the discussion of this paper, that the alleged increase of coasting time on the Second Avenue division of the Manhattan Elevated meant $1,000 per day saved out of $4,000 for power.

The direct economy seems to be marked enough, but it is not the only one, for the value of a driver is computed by taking out the ratio between his total running-time and the portion of that time spent in coasting as recorded by the clock, so that he is anxious to reduce the station stops to the utmost, and in that way the service is accelerated.

The paper as it stands will be of greater interest to the London Tube engineers than to tramway engineers, as it deals with heavy trains running at very short headway over a section with stations every 1,760 ft.; but the facts can be applied with equal cogency to urban tramways, where the number of stops per mile is higher, and high rates of acceleration and braking are by so much more important.

We were impressed favourably with the German system of time-meters when it first came under our notice, and we have watched the slow but convincing progress of that system in this country with interest; but the latest development of the idea should become popular more quickly, as it takes into account the time spent in braking as well as in using power. "Coasting is the recovery of power already used, and is the key to the problem."

One thing is quite certain: whether ampere-hour meters, watt-hour meters, power-time clocks, or coasting-time clocks are installed on the cars, whether the poles or the tracks are marked to indicate when power is to be shut off, or whether some other ingenious device is used with the object of cutting down the consumption of energy, every record is of success in the attainment in some degree of that object; and we are convinced that every board of directors and every tramway committee which has not authorised its officials to take the necessary steps to secure the substantial economy which is bound to follow on a very modest expenditure, is either ignorant of modern progress or careless of the interests which its members represent.

Rolled-Steel Wheels.

A Carnegie expert read a paper recently before the Street Railway Association of the State of New York, in which he gave an account of the general lines of manufacturing the Schoen all-steel wheel. The life of these wheels, of which there are 400,000 in use, is 150,000 to 175,000 miles, but the author gives no reasons which help us to see in what ways such a wheel is superior to the steel-tired wheel, which is said to have as long a life, and is scrapped only as to its worn-out tire at the end of any one of its lives.

A more interesting paper, read at the same meeting, was one on gears and pinions, and the general conclusions are worth noting:—"All tests and experiments clearly indicate the advisability of using high-grade heat-treated steel, or case-hardened steel, for gears and pinions used with railway motors which are of 75-h.p. capacity or under, while heat-treated carbon steel alone is best suited for gears and pinions which are subjected to higher tooth-stresses by motors of large capacity; for not only will the breakage of the teeth be reduced to a minimum, but the cost of the gearing per car-mile run will be considerably lowered, notwithstanding the high price paid for it."

Tramway engineers should read the whole paper in the *Electric Railway Journal* for July 2nd, for it is evident that there is a good deal of money to be saved by choosing the right kind of gear material. Our practice is much the same now as it was in the beginning of electric traction, and it is reasonable to suppose that progress has been made somewhere in the world in the matter of gears as in every other thing.

Two or Four Motors?

Some years ago a good deal was said and written in America and over here about the correct number of motors to drive a double-truck car. The Electrical Review was inclined to uphold the growing American practice of using four motors, thus driving all axles, and utilising 100 per cent. of the car-weight, as against the so-called maximum traction arrangement with one larger motor per truck and two idle axles per car, which carry from 25 per cent. of the total weight, except when they are kicking up in the air and jumping points.

For level roads and average British speeds possibly two motors per double-truck car would be satisfactory enough, but as grades or speeds increase, the distribution of motors becomes a serious matter, and the case for four motors has not been weakened since the controversy first saw light. This opinion is strengthened by a discussion which took place at a recent meeting of the committee on equipment of the American Street and Interurban Railway Engineering Association. A perusal of the report of this meeting in the *Electric Railway Journal* shows us definitely that a four-motor equipment is more satisfactory than a two-motor equipment wherever grades are severe, wherever high acceleration is required, or wherever high speeds are in vogue. None of the speakers are reported to have made reference to braking, but it is evident that wheel-braking upon four equally loaded axles will be more effective than upon two pairs of unequally loaded axles. Theoretically this may be incorrect, but stern practice and human brake-adjusters make all the difference.

We look forward to reading a report on the whole subject, which is in course of preparation by the superintendent of shops of the Baltimore Tramways Co.

The writer of a leading article in the *Electric Railway Journal* strives to make a case for one high-powered motor per truck on the ground of weight saved, but the figures look as if a comparison were being made between the most up-to-date motors and motors of some years' standing. Undoubtedly there is a considerable saving in dead weight to be credited to the two-motor equipment, and, as we said before, undoubtedly a two-motor equipment will fulfil all conditions admirably in a great number, probably in a majority, of cases; but there is nothing to beat a four-motor car for good all-round service and safety on hilly lines or on routes which are worked at high speeds.

Payment for the Preparation of Schemes.

It is now about three years since an energetic advocacy was put forward in Germany in favour of local authorities and other bodies being required, when approaching manufacturing firms with a view to the preparation of schemes for lighting, traction and power transmission, to pay the comparatively large expense involved in the matter. Whether the plea then advanced had any practical results cannot be definitely asserted, but an instance has now to be recorded in which contributions have already been made in connection with an electric railway scheme between Cologne and Cassel. The promoter of the plan is the Bergmann Electrical Enterprise Co., which is the so-called trust recently constituted by the Bergmann Electricity Works Co. Apparently the initiative in the matter has been taken by the former, and not by the local authorities, and it is therefore all the more agreeable to the promoting company that some of the local authorities have given practical proof of their desire to facilitate the preliminary works. Thus, the Town Council of Cassel has granted the sum of £100 for the purpose, and the towns and communes of Waldeck and Westphalia, which would also be connected by the railway, have also sanctioned or promised contributions, whilst Cologne likewise proposes to make a grant; but the town of Corbach has been compelled, owing to the unfavourable situation of the finances of the locality, to refuse to follow their example. Several districts have offered to place land free of charge at the disposal of the promoting company for the construction of the railway, but in the final result the latter will have to deal with the Prussian State Railway authorities, who, generally speaking, are opposed to such schemes on the ground of probable diversion of traffic from the ordinary railways.

ELECTRIC DRIVING IN TEXTILE MILLS.

By L. CROUCH.

The whole problem of the electrification of textile mills is of comparatively recent inception—indeed, its chief growth has been confined to the last few years. The stakes at issue were so high, and the innovations proposed so radical, that progress was naturally slow in the early stages, but the results of electrical working have proved so satisfactory that its future expansion cannot be doubted. Several papers have recently been published on this subject, among them a review by the author in these columns,* but so wide is the field that no apology is required for the following notes further examining the question of electric driving in the textile industry.

It is shown below that several slight but important alterations in the design of textile machines are advisable in order to secure the full advantages of electrical operation, but up to so recent a date as 1907 the design of textile machinery specially for electric driving was carried out by British makers to a very limited extent, and even then mainly on plant built for foreign customers. So far as can be at present estimated, the spinning mills of Lancashire require for their operation some 500,000 H.P., while a similar demand is yielded by the weaving, bleaching, printing, dyeing and finishing industries; of the grand total textile demand of Lancashire, probably exceeding 1,000,000 H.P., only some 5 per cent. or 6 per cent. was electrically operated in 1908, and it is improbable that more than 10 per cent. is electrified at the present time. Much of this immense demand is supplied by steam plant of such high grade, and such recent installation, that its replacement by electrical apparatus is out of the question for 10 or 20 years at least. The remainder offers a splendid field for electrical enterprise, both as regards equipment and power supply.

For reasons clearly stated in the previous article already referred to, new mills offer a simpler and more satisfactory solution to the electrical engineer than do steam mills, the conversion of which is controlled by many complex factors, some of which materially detract from the advantages properly associated with electrification. Nevertheless, both new and old mills are now quite commonly equipped with electrical in place of mechanical drive. A study of the conditions to be met, and of the results obtainable, therefore becomes of great importance to electrical engineers.

The Wide Influence of Electric Driving.—It is often erroneously assumed that electric driving amounts to nothing more than a conversion of the *means of transmitting power* from the prime mover to the textile machines, *i.e.*, that the electrical equipment is no more than an alternative to belting, gearing and shafting. Fortunately, electrical operation is subject to no such restrictions; it undoubtedly affords in general a more efficient means of transmitting power from point to point, but it has also many other advantages, some obviously practical, some abstract, but none the less valuable. The nature and extent of the chief of these advantages are examined below.

Reliability.—It is frequently urged that in mechanically-driven mills only the breakdown of the prime mover has to be guarded against as a possible source of shut-down, whereas in electrically-driven installations every motor becomes an added risk of breakdown. Such a contention is ridiculous; so small a failure as the seizing of a shaft bearing in a remote part of a textile mill may, with mechanical drive, cause temporary complete cessation of work, while broken driving ropes, &c., cause more or less hindrance, according to circumstances. On the other hand, with electrical driving, any failure, whether of bearing, shaft, rope or motor can only affect the machine or group of machines driven by the latter. The total number of breakdowns per annum (mostly trifling) may *possibly* be somewhat increased by the use of departmental, group or unit drive, as the case may be, but in return is secured the valuable guarantee that any trouble, great or small, only affects the machine or group of machines directly concerned.

Efficiency.—One of the chief claims in favour of electric driving in textile mills is the higher overall efficiency of the plant from the prime mover to the productive machinery. One would expect that this claim could be very definitely substantiated or refuted, but whereas power measurements can be very accurately made at any desired part of an electrically-operated scheme, and the energy consumption thus completely analysed, any such measurements in the case of mechanically-driven mills are difficult to make, and of very doubtful accuracy. The "friction" card of a steam plant enables the determination of the total power consumed by friction under light-load conditions, but the friction loss on full load under the ordinary conditions of everyday working is quite different, and can by no known means be measured. The power required to drive the engines, main ropes, shafting and belts, but excluding the textile machinery (*i.e.*, the light-load friction loss), may equal 20 per cent. of the full-load I.H.P., the corresponding figure in the case of weaving sheds being 25 per cent. For general estimating purposes it may be assumed that the loss per belt or rope transmission under normal load = 5%—7% normal I.H.P. : 100 ft. of well-kept line shafting will require about 1 B.T.U. per hour to overcome its friction losses. In the case of an electrical equipment the efficiency of the generator, motors and cables may be taken as 95 per cent. in each case so that the overall efficiency from generator shaft to motor shaft = about 85 per cent. In the latter case, even with tolerably large group driving, the total amount of belting and shafting is

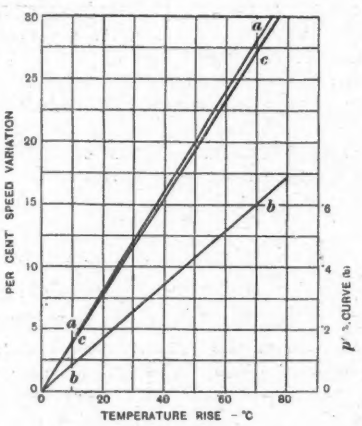


Fig. 1.

considerably less than in a mechanically-driven mill; at an outside estimate, the friction losses in ropes, shafting, &c., should not exceed 15 per cent. in an electrical equipment. Under these circumstances the overall efficiency of the latter would not greatly, if at all, exceed that of a mechanically-driven system, but even so the electrical system would possess the valuable advantage that by making periodical measurements the initial efficiency could be easily maintained in ordinary working, whereas the efficiency of a mechanical system, originally as high, would soon fall by 5-15 per cent. or 20 per cent. owing to deterioration in bearings and gearing. Such increases in friction could not be isolated as in the case of electric driving, and hence would remain practically unremedied, though their existence would be evident by the increased total I.H.P. required for a given output. Mr. W. B. Woodhouse (*Cassier's Magazine*, May, 1910) states that the efficiency of spur gearing, 95-96 per cent. when new, falls to 78 per cent. when old. Though individual circumstances vary widely, it may be taken that, at the present day, usual friction losses on no load and full load in mechanical and electrical mills are :—

	Per cent. full load I.H.P.	
	On no load.	On normal load.
Mechanical drive	20-30 %, or even 50 %	30-50 %, or 60 %
Electrical drive	15-20 %	25-30 %

Electric driving, by enabling exact power analysis, permits of easy and certain isolation of every source of inefficiency; Woodhouse (*loc. cit.*) quotes one striking instance of such, in which a heavy friction loss was traced to the spindles of a certain set of frames; the lubricating oil used was changed, and a saving of *10 per cent.* in the power required by the frames was effected.

* Electrical Review, April 15th, 1910, page 580, *et seq.*

Type of Motor, Speed Variations, Group and Unit Driving.

Under this heading must be considered a number of closely interconnected factors depending on a series of important principles, the correct appreciation and application of which largely determine the success of any electrical installation.

Type of Motor.—The type of motor in almost universal use for the driving of textile machinery is the three-phase A.C. motor of the "squirrel" or "wound" rotor type, as may be required. Textile machines require in general a smooth, constant speed drive, owing to the nature of the processes carried out and the low mechanical strength of the materials handled. In some processes a certain speed variation is necessary from time to time, but, though speeds n', n'', n''', &c., may be required for various processes, the R.P.M. *during each process* must usually be constant at n', n'', n''', as the case may be. The speed of A.C. induction motors is, for given load conditions, determined only by the frequency of supply, whereas such extraneous factors as the temperature of windings, and so on, largely affect the speed of D.C. motors (see also below). A three-phase induction motor seldom falls below 2—4 per cent. from synchronous speed, and, under a constant load, this class of motor yields practically constant-speed machines. (See also notes concerning figs. 2—4.)

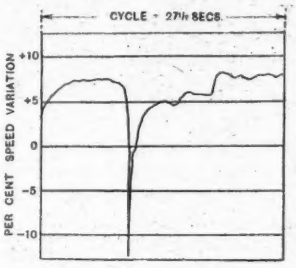


Fig. 2.

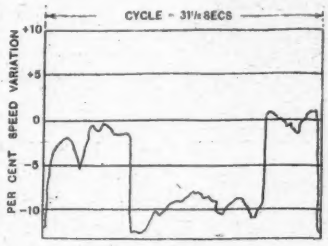


Fig. 3.

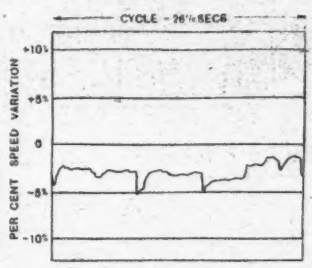


Fig. 4.

The variations in speed which may occur in a D.C. shunt machine, due simply to *heating of the windings*, are as follows (see also fig. 1) :—

(*a*) Suppose the pressure applied to the field coils to be constant at v volts, and the pole cores to be unsaturated, it will be apparent, on consideration, that the armature speed will, other things being constant, rise from n' to n'' R.P.M., owing to a rise in temperature of $t°$ C. in the field coils, such that—

$$n'' = n' (1 + 0{\cdot}004\, t) \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

or the percentage increase in speed due to field heating—

$$= p = 0{\cdot}40\, t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

(See curve (*a*), fig. 1.)

(*b*) Owing to the heating of the armature coils (through t_1 °C.), the back E.M.F. of the motor must fall from—

$$E_b' = V - C R'$$

to

$$E_b'' = V - C R' (1 + 0{\cdot}004\, t_1).$$

Other conditions remaining constant, this involves—

$$n'' - n' = 0{\cdot}004\, t_1 C R' . K,$$

(K = a constant)

i.e., percentage *decrease* in speed due to armature heating =

$$p' = \frac{0{\cdot}4\, t_1 . C R_1}{V - C R_1} \quad \ldots \quad \ldots \quad (3)$$

(See curve (*b*) fig. 1.)

Hence the approximate net increase in speed caused by temperature rise is—

$$P\,\% = p - p'. \quad \text{(See curve (}c\text{), fig. 1.)}$$

To illustrate the influence of the above factors, a 400-volt 70-amp. motor is assumed, with armature resistance = 0·12 ohm. Assuming the temperature rise of armature and field coils to be equal, the values of p, p', and P are as in Table I (see also fig. 1). If $t = t_1$, it is merely necessary to compound the ordinates of (*a*), (*b*) corresponding to t and t_1, to obtain the approximate value of P. As a rule, the field core is fairly near saturation under normal conditions, hence the speed variations are less than would appear from Table I; other minor influences, such as brush heating, leakage, and iron loss variations are neglected above; their importance is seldom great.

TABLE I.

T rise °C.	p %	p' %	P %	T rise °C.
10	4	0·09	3·9	10
20	8	·17	7·8	20
30	12	·26	11·7	30
40	16	·34	15·7	40
50	20	·43	19·6	50
60	24	·52	23·5	60
70	28	·60	27·4	70

An increase in speed of 8-10 per cent. in D.C. shunt motors due to the above cause is by no means unusual, but squirrel-cage motors can readily be kept within about 2 per cent. of synchronism under all conditions.

As a rule, a friction clutch is provided to enable the smooth starting of spindles, &c., as well as to ease the load on the motors. The use of squirrel-cage motors with auto-starters and friction clutches provides the safest equipment possible (as regards fire risk). Such safety is vital, for, especially during the early stages of its manufacture, cotton is remarkably inflammable; indeed, the fine "cloud" of cotton,* passing from a carding machine to the rollers which form the first sliver, is almost explosive in its inflammability.

Single-phase motors are generally inferior to three-phase machines as regards starting torque and general operating convenience and reliability; to meet the requirements of textile and similar applications, however, three-phase motors, adapted for use on single-phase circuits, have recently been placed on the market; these machines avoid the usual deficiencies of one-phase motors.

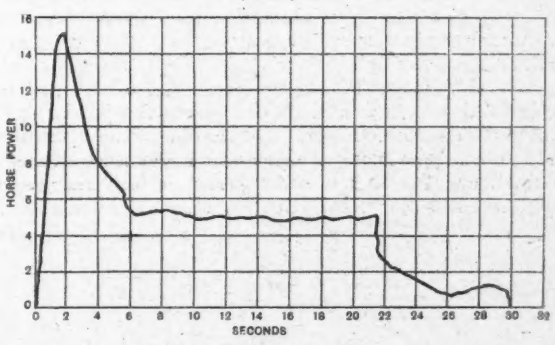


Fig. 2A.

The air in many textile departments is humid, dusty, and at a temperature of 80-90° F., a combination of conditions specially favourable to sparking and insulation failures. Under these conditions the advantages of the squirrel-cage motor, with its freedom from sliding contacts and its thoroughly robust construction, are obvious.

Speed Variations.—Not only is the three-phase induction motor, under present conditions, a more constant-speed machine than the D.C. shunt motor, but also it is better able

* Visitors to the Japan-British Exhibition in London may see such a "cloud" at the textile exhibit in the Machinery Hall.

to follow, with minimum speed lag and fluctuation, variations in the load placed upon it. This statement is excellently illustrated by figs. 2-4, based on similar curves recently published by Mr. Woodhouse (*Cassier's Magazine*, May, 1910). This set of curves shows the demand of a certain mule frame (fig. 2A) and the corresponding speed variations (measured at one frame) with steam, D.C. motor and A.C. motor drives of a group of four such frames, figs. 2, 3 and 4 respectively. The fluctuations due to variations in the speed of the prime mover, which show in practice as ripples on the present speed curves, are eliminated for clearness. The resulting diagrams show that, though D.C. motors

FIG 5

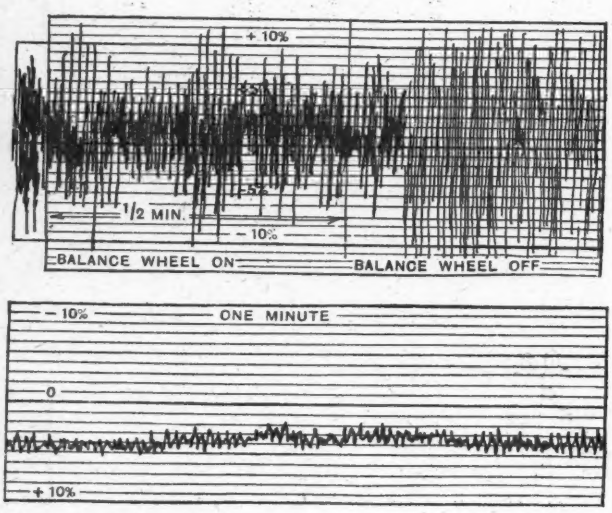


FIG. 6.

give a much steadier drive than mechanical transmission, three-phase machines are considerably better still in this respect.

The repeated rope drive of a mechanical system does not conduce to so steady a speed as might be expected at the textile machines. A rope transmission between two shafts no doubt prevents a surge on one being transmitted in its full intensity to the second, but, as every rope slips and creeps, and as long shafts are required in mechanical systems, ± 12-15 per cent. oscillations in shaft speed from the normal are undoubtedly existent in such cases. The diagram (fig. 5) given by Woodhouse (*loc. cit.*) shows the high frequency of these speed oscillations, and the very limited utility of a heavy fly-wheel belt-driven from the shaft as a means of subduing the fluctuations. Fig. 5 may well be contrasted with fig. 6, the speed curve of a similar shaft driven by an electric motor. The smoother drive obtainable in the latter case allows of higher speeds, and hence increased output, and any such cause, resulting in increased output with no additional "fixed" charges, is especially desirable.

(To be continued.)

Lamp Taxation in Germany.—The opinion was expressed a week ago, in referring to the results of the taxation of lamps and accessories in Germany during the first six months of the currency of the impost, that the amount realised was probably less than was estimated when the taxes were first proposed. A correspondent of a German newspaper now points out that the taxes have not yielded one-third of the calculated sum. Apart from this circumstance, it is submitted that the taxes are extraordinarily high, as is shown by an instance cited by the Hansa Federation. It appears that the owner of a factory recently expended £9 11s. on the purchase of a stock of arc lamp carbons for the winter, whilst the amount of the tax on this quantity was £7 15s. It is considered that this case proves how burdensome and how restrictive the tax is in its bearing on the lighting industry, and it is suggested that it should be repealed.

Tramway Valuation.—A Special Committee of the Tramways and Light Railways Association members representing Scottish tramway companies is being formed, to take up the matter of the assessment of tramway undertakings in Scotland.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electrical Organ Blowing.

Having given a great deal of time and thought to the question of electric organ blowing, I was much interested in the article appearing in your issue dated September 9th. From the description given it appears that an electric motor is employed to operate the feeders of the organ by means of a worm gear and three-throw crankshaft, the speed of the motor and consequently the amount of wind being controlled by a resistance in the armature circuit, this resistance being actuated automatically by the rise and fall of the organ reservoir.

This is more or less standard practice; but it is claimed that the consumption of power is in almost strict proportion to the amount of wind required. This is, of course, absolutely incorrect for series regulation, because the current from the supply mains is practically constant, irrespective of the motor speed; in fact, this method of control is quite the most inefficient that can be adopted.

Organ blowing by means of fans driven by electric motors is referred to and criticised, because the power consumed at no load (throttled-delivery outlet) is stated to be nearly as much as at full load (full-delivery outlet). From figures I have by me, I see that in one installation the full-load power amounted to 2,800 watts with full-delivery outlet, and 1,620 watts with throttled-delivery outlet. Another case shows 1,900 watts and 1,000 watts respectively under the same conditions.

From these figures it will be seen that organ blowing by means of electrically-driven fans is quite efficient, and it may be added that it is more convenient than the somewhat cumbersome method of operating the feeders through a wormgear and crankshaft, with speed regulation by means of a series armature resistance controlled from the organ reservoir.

Contrary to another statement in the article, I would point out that the method of blowing excess wind to waste is not wasteful of power as the author would suggest, although for obvious reasons this arrangement cannot always be adopted on account of noise; but from organs I have tested the power required to drive when blowing to waste will only be equal to about half the full power, so that this arrangement, as well as the fan blower, is considerably more efficient than that described in the article.

With regard to the time taken after switching on, 10 seconds is a very long time to wait before commencing to play the instrument, and this length of time would cause a great deal of inconvenience in most cases. I have tested an organ-blowing installation when one has been able to play the full organ within *one second* after switching on, and although this short period may not be absolutely necessary in many cases, the length of time should not be more than five seconds as a maximum.

Organist, A.M.I.E.E.

London, *September 14th*, 1910.

Electricity from Wind-Power.

We saw in the Press a day or two ago an account of a paper read before the British Association, at Sheffield, by Prof. Fessenden, upon the use of windmills, &c., for power purposes.

We noticed that several of the papers mentioned our name as being successful pioneers in this development. This statement is correct, and we have now something like a dozen wind turbines running for the production of electric power for the lighting of houses, driving machinery, and charging motor-cars, &c.

One of the most interesting cases is an 18-ft. wind-turbine which we have recently erected in the Black Country, near Birmingham. A striking feature of this plant is that it stands upon the tailings of an old disused coal mine, from which all the coal has been extracted. The old ruined headgear of the mine stands in the background, and the whole very strikingly suggests the truth of the Professor's

statement that the time will come when, our coal being used up, we shall have to fall back upon the wind. Here it has actually taken place, and the local vicarage and the Anglican Church are being supplied by electricity from the wind. The current is used for lighting the church and blowing the organ, and also for lighting the vicarage, and charging the accumulator cells of the vicar's motor-car, and it is proposed to use it for cooking.

We should not like to undertake, as Prof. Fessenden suggests, to run all the electric lighting stations of the country by means of windmills placed on the coast, but we can undertake, as a commercial proposition, to do all the cooking and lighting required for practically any country house in the kingdom, and the plants which we have already running demonstrate that the proposal can be dealt with on a commercial basis. When the plants are once installed they cost nothing.

J. G. Childs & Co., Ltd.

London, N.W., *September 15th*, 1910.

Modern Lighting.

With reference to the article in last week's Review by Mr. Toone, I note that he explains how he arrives at the comparisons of gas and electric power as quoted in Table I, but no explanation is given as to how he arrives at his percentage of "visible" total.

In respect of the consumption, I note that he considers the recently-developed quartz mercury vapour lamp to have advantages over all other systems.

Enquirer.

The A.E.G. Deal.

I should be interested to know if the Swiss (Electric) Bank's share of the A.E.G. and F. and G. Lahmeyer Works Co.'s deal is the controlling shares of Messrs. Escher Wyss, of Zürich, which had passed into the hands of the F. and G. Lahmeyer Works, and which the Swiss were anxious to retrieve.

Colin.

Coal-Cutting Machinery and Electrical Accidents in Mines.

In reply to Mr. Austin Burdon, the best method is to have the earth wire *bare*, and not *perfectly insulated*, as he suggests. There is also a method of connecting the earth wire to the earth plate so that any chance of its becoming accidentally disconnected is very remote.

The Writer of the Article.

Municipal Trading.

The Bill about to be promoted, to give municipalities the necessary powers to undertake the work at present carried on by contractors, has already met with strong opposition on the part of the ratepaying public, who object to the principle of stifling or interfering with private enterprise. It would seem that those responsible for the control of municipal affairs are not content with one monopoly, but must needs demand another. What is this monopoly to the ratepayers, if secured? In any case, what is the net value of the powers sought? These are questions of vast importance at the present moment, when ratepayers' money will be spent freely, presumably, to advance their interests.

The substance of this Bill is in reality a will o' the wisp, leading not to green pastures, as the public are led to believe, but to a quagmire, wherein ratepayers' money will be sunk beyond hope of recovery.

Does the municipal engineer imagine that he can carry on the work of a contractor and even make sufficient to pay expenses? If he has such an idea in his mind at all, it can only be because he has never tried it. It has occurred to me that various matters of importance have entirely escaped consideration; for instance, "load factor," a term he is fond of using on every possible occasion, is evidently overlooked, although "business factor" (a term which applies to the contractor) is of vital importance to the success of a contracting business, and no municipality within itself offers anything like sufficient continuity or variety of business to keep a respectable staff together, even if a monopoly were secured, which I contend is impossible.

Further, it is apparently forgotten, intentionally or otherwise, that departments of this kind have been tried over and over again, both by private companies and municipalities, resuting in utter failure.

Is this clamouring for new fields for experiment an admission that the municipal engineer finds insufficient employment in his present duties? Or is it that with threatened decline in revenue from modern improvements he fears reduction in salary? One thing appears certain, the modern municipal officer who is sufficiently imbued with desire for his own advancement, irrespective of other interests, is at the root of all controversy between contractors and station engineers. He has sown the seed of dissension with regrettable persistency, and expresses surprise at the dissatisfaction and distrust that exist. There are, however, matured and experienced engineers with whom the contractor finds no difference of opinion; their aims are mostly identical, as indeed they should be, and such men look with disfavour on any conflict of interests that must annihilate the possibility of co-operation.

I will believe that co-operation is impossible when a serious movement to bring it about has met with no response. In this respect the municipal element is entirely out of court. While some have professed eagerness to bring about a conference to attain this object, others, as if determined to prevent it, have increased their spleenful and abusive policy wherever they can find a hearing.

Is it reasonable to suppose that the depletion in revenue to the supply station by the metal-filament lamp can be made good in a day? Is the enormous cost of the modern sales department justified by the additional units secured, especially when this same business can be secured through contractors for nothing?—Interesting points, when at least one municipality which started out with a flourish of trumpets has already had to fall back on the sale of metal-filament lamps to help keep the department above water. The profits from these sales may for the moment help to prevent disaster, but what of the forced and permanent shrinkage in units therefrom? Perhaps this is one way in which modern inspiration upholds the dignity of its calling, and gives a first lesson to the contractor. It requires no philosophy to descry the danger consequent upon such mad policy. Monopoly by contractors never has existed, and never will exist, and monopoly is the only excuse given, so far, for municipalisation.

Money was borrowed on the security of the ratepayers to save them from the ravages of monopoly. Money is now to be spent in the effort to obtain monopoly in a province at present represented by a precarious and speculative business. It is everywhere admitted that prices for electrical work are so nearly cost price that they have reached rock bottom. Excessive competition is the reason, which, so long as it continues, must benefit the purchaser. With this state of affairs in view, will anyone credit the public mind with sufficient imbecility to agitate for legislation that will raise prices indefinitely, and at the same time place them under the heel of the borough official? But what are the guardians of the people doing while all this is going on?—I mean the Borough Councillors. Their attitude is more or less that of stolid indifference. Ask yourselves what these men promised on the eve of election, and note their attitude afterwards, and judge the possibility of anything like reasonable treatment for the contracting industry. I cannot conceive a more abominable injustice than for a municipality to forsake the time-honoured course of preserving inviolate the freedom of its subjects from the tyranny of State-aided competition, whose machinations would do grievous harm to those who are, through the payment of rates, obliged to subscribe to their own persecution and undoing. The whole thing is a scandal from beginning to end, for which the public have to thank the existence of that fantastic institution, the Electricity Committee, who are delegated to control and conduct the affairs of a business with which they are entirely unacquainted, and who readily admit their impotence and incompetency to follow arguments of a technical nature. The gullibility of the average Committee is astounding, a fact which is readily perceived and enjoyed by their commanding officer.

It will be interesting to note the attitude of manufacturers. If I mistake not, they are chafing at present. Are they to depend upon the favour of the particular Jack-in-office (who is mantled with the importance of buyer for his Council) for their market in future? I think not. I can see them becoming contractors themselves, and who will blame them? Finally, we shall look forward to the pressure of public opinion in favour of a strict commercial scrutiny of the accounts of separate municipal departments; that fulfilled, the next move will be an experienced Government commissioner delegated to attend and supervise the control of municipal undertakings.

Duncan Watson.

London, W., *September 20th*, 1910.

The Association of Mining Electrical Engineers.

With reference to the letter of "A Council Member" in your last week's issue regarding the question of the above Institution doing something to improve the status of the colliery engineer, there seems to be some little misunderstanding as to what this means. There may be some effort made by the Council to improve the present colliery electrician in his knowledge of the work to be done, by forming an examining board, and granting certificates to those who pass. But is this the policy of the ELECTRICAL REVIEW, as suggested by them over and over again in their leading articles on this question? And it must not be forgotten, it was the "E.R." who first suggested forming such an Institution.

It is a fact, however, that the present Association has no intention of suggesting to the Home Secretary that the colliery engineer be provided with a certificate similar to that which the colliery manager already holds, and further, so long as it is mainly ruled by colliery managers, it *never* will do so. It is also a fact that the colliery manager very much wants a better class of electrician than he can now get, and probably would be prepared to pay a little higher salary, and no doubt it would be some satisfaction to him to know that if he could get a man who carried the Institution's ticket he was doing the very best he could to comply with the Act in regard to the *competent* person. So that, in all, the Institution is to be at least a useful kind of thing for the colliery manager. He can also have his deputies, coal-cutter drivers, fitters, &c., all ticketed *First-class electricians*, and thus pick and choose where he likes.

The policy, however, of the E.R., as I understand it, is that there ought to be a certificated engineer with a certificate granted by the Home Office, and equal in value to that of the underground manager. At present there are two certificates for colliery managers, a *first class* and a *second class*, and in law the colliery manager, with his second-class ticket, is above the colliery engineer or electrician in authority and responsibility. Does the Association of Mining Electrical Engineers really intend to do anything to alter this? It would probably interest "A Council Member," as well as other members of the Council, to read carefully, and get the drift of, a few of the E.R. leading articles dealing with this subject.

A Non-Council Member.

Overcrowding in the Ranks of Central Station Officials.

Replying to "D. G.'s" inquiry of September 9th, 1910, in these columns, under the above heading—Have I found premium pupils to be workers or loafers?—I must admit having met a few cases "proper bhoys," but I would not condemn the whole on that account. Moreover, I do not wish to express my opinion too freely in this direction. If there were exams. coupled with practical tests, the examiners' report would speak for itself; no one could then say that pupils or any other assistants were judged and engaged from mere observation, and importance should be attached to the certificates gained.

With regard to the correspondent "C," who suggests that an association for assistants would have the flavour of a Bricklayers' Union, &c., I am afraid this would be the case, but it would not be such a disgrace, considering our chiefs have lost interest in their assistants generally. Again, they are not backward on the Continent. Associations have been formed there, so we should, after all, only be living up to the times—"hard times."

J. P.

LEGAL.

TORQUAY CORPORATION TRAMWAYS.

(Continued from page 450.)

ON Wednesday, September 14th, MR. W. H. PATCHELL, consulting engineer, Westminster, who has spent a fortnight at Torquay examining the system, gave evidence in furtherance of the company's application. At Torquay studs failed at the rate of 24 per month in 1906, 34 per month in 1909, and 47 per month in 1910. The carbonising of the oil in the stud pots was a defect that could not be got over. The oil was put into stop arcing, but this could not be altogether stopped. They could minimise the carbonising by making the oil vessel such as would empty easily, or by making a larger vessel so that the oil did not carbonise so quickly, but it was only a question of time. The thick oil sometimes leaked into the thinner oil in the inner pot and prevented the switch from working freely.

In reply to the ARBITRATOR, WITNESS added that this should not be so, but "oils had a way of so doing." Water also got into the inner pot, but it was difficult to say how much got in by leakage, and how much was caused by condensation of the air in the inner pot. There was always a space at the top of the pots, into which air was drawn and would condense. He saw no way of remedying this, because the pot could not be hermetically sealed. The breaking of the inner pot by heavy traffic over it was another fault of the system; and heavy traffic, such as lorries and traction engines, was particularly bad on the Torbay route. In view of the traffic on the road, and seeing that the road was sea-washed, and that the Corporation watered it with sea-water in summer, it was a particularly bad route for any surface-contact system. Explosions occurred in the pots through water getting in, and from other causes. This could only be prevented by ventilating the oil switches, and such a thing was impossible. A further fault was that the carbon-contacts were continually breaking and snapping—a fault common to all surface-contact systems. The leakage of oil from the outer pots would increase with age, as it was now found that the oil acted in time on the bitumen used to seal the pots and caused leakage. Accidents to horses also happened, apart from shock, because some studs were more than a quarter-of-an-inch above the road surface, and the animals tripped over them. The Board of Trade Regulations only permitted studs to project ¼ in. above the road surface, but this regulation could not be followed closely in a place like Torquay, because of the generally uneven road surface.

Questioned as to Mr. Mordey's report to the Torquay Council showing the cost of tram systems in seven selected towns, WITNESS said that Mr. Mordey had chosen towns in which overhead systems had been in operation eight or ten years, to compare the cost of working with the underground systems. Naturally the cost would be heavier on well-developed systems than on a system that had only been working four years, such as at Torquay. Witness had taken the costs of working in 78 towns which had tramways for from four to 12 years, and the average cost per car-mile was 1·14d. He also took 14 towns (including Belfast) where the tramways had been working for an average period of 3·3 years, and the cost was 1·836d. per car-mile, as compared with the 1·14d. in the whole 78 towns. This showed that the working expenses greatly increased with time, and Mr. Mordey's report was thus misleading. Witness said further, that it would be very difficult to work a surface-contact system on the Torbay route in connection with an overhead system for the Paignton extension. If he were the Board of Trade he should want absolute proof that further improvements would remedy existing defects in the system before he would sanction further experiments. He was of opinion that the Dolter system could not be so improved as to eliminate the causes of live studs. He had seen the drawings of Mr. Mitchell's latest invention in the arbitration room (the invention had not been offered to the company). Witness had searched at the Patent Office and found that from 1905 to 1908 Mr. Mitchell had put in specifications of 13 patents in connection with the system. The present invention seemed to be an application of an invention of 1907 to Torquay conditions. The invention got rid of the inner pot, and altered the stud casing. Witness did not think the invention would remedy the faults in the Dolter system. The single pot would mean that they would have to find an oil heavy enough to keep out salt water, and thin enough to allow the switch to work freely. Witness knew of no such oil. He had no faith in either the G.B. or the Lorain system. The engineer at Wolverhampton, where the latter system was used, had to admit the defect of live studs.

MR. LLOYD briefly cross-examined this witness, and MR. VESEY KNOX intimated that this closed the company's case.

Evidence for the Corporation was then called.

MR. CHARLES E. SHAWFIELD, resident and consulting electrical engineer to the Wolverhampton Corporation, said that in 1902, after examining both the Dolter and the Lorain system, he recommended the Corporation to adopt the latter. The Council agreed to do so if the Lorain Co. would put down and work 12 miles of track at their own expense for a year. This was done, and the system worked satisfactorily, and the Corporation took it over. It continued to give satisfaction, and in 1904 a further 8 miles of track was laid. Last

year a further 1¾ miles was added, and the 21¼ miles now working, gave satisfaction. The cost of the system was greater than that of the overhead system, but not much greater than that of the Dolter system. The actual cost of construction in Wolverhampton was £1,800 per mile for a single track. This was £1,000 per mile more than the overhead system could have been constructed for, based on an actual tender obtained for the installation of the latter system. He believed that the expenses of maintenance with a surface-contact system grew less with time. For the last three years the average cost of maintenance at Wolverhampton was 6·4d. per car-mile, or 9·37d., including all capital charges. There had only been trouble with live studs to a limited extent. They had caused no inconvenience or injury to anybody. The number of live studs reported to the Board of Trade were less than one-half stud per mile of track per year. He agreed that anything on the line, such as snow, was disastrous to a surface-contact system.

Cross-examined by MR. VESEY KNOX: Can you refer me to any other engineer in this country who has recommended a client to adopt the Lorain system?—That is rather a wide question. Two well-known engineers have expressed their approval of the system, Prof. Kennedy and Mr. Henry Lee, of Birmingham. Witness agreed that the consumption of current per car-mile was about a ½ unit greater on the surface-contact system than on the overhead.

MR. KNOX read a statement made by witness in 1909 at a meeting of municipal engineers to the effect that the live studs on the Wolverhampton track in 1908 numbered 52. How did he reconcile that with his statement about the half stud per mile of track per year?—WITNESS said that for Board of Trade returns it was not necessary to report a stud as "alive," unless it showed a voltage of over 50. The average of defective stud pots was two per mile of track per year.

MR. KNOX pointed out that in the second year of working the Lorain system 109 defective pots were reported to the Board of Trade.—WITNESS said the defects were more numerous at first. Continuing, he stated that the Lorain system was in use nowhere in the world but in Wolverhampton, but he believed a contract had recently been made to lay the system in an American town. Witness could not say he would recommend the Dolter system if the Lorain did not exist. The oil used at Wolverhampton to keep moisture out of the pots was a thick oil, and it could not be used in a single pot of the type invented by Mr. Mitchell. In conclusion, witness said, in his opinion, the Lorain was the best system of electric traction in use.

The ARBITRATOR: Then why is it not generally adopted?—WITNESS replied that many Corporations had inquired about the system, but they would not adopt it because the Lorain Co. would not grant them the same terms as they had granted Wolverhampton, where they worked the line at their own expense for 12 months. The company thought they ought not to be asked to do this elsewhere, as it had proved a success at Wolverhampton. The system had also suffered from a "campaign of calumny" in the Press. At Wolverhampton they had never had a stoppage of trams through a defect in the system during the whole period of its working.

At this point the matter of adjournment was considered.

MR. LLOYD said the Corporation had told him the case would only last three days, and he could not proceed with it after this sitting. He asked for an adjournment for a month.

The ARBITRATOR said he was told by the Corporation that the inquiry would last six days, and he thought they ought to keep on with it.

MR. VESEY KNOX protested against an adjournment, as it would delay the construction of the new system, if the award went in the company's favour.

It was finally decided to proceed with the arbitration.

MR. LLOYD said he should therefore address the Arbitrator on the case, and leave a successor (whom the Corporation might appoint) to put the other witnesses forward. He first asked what the Arbitrator's decision was on the point of law he raised at the opening as to his jurisdiction in the matter.

The ARBITRATOR said he should meet the difficulty by presenting his award as a special case.

MR LLOYD then addressed the Arbitrator for the Corporation, and said that, from the first the Torquay Council were so adverse to the overhead system that when it was decided to allow the construction of tramways in the town, a deputation went abroad to seek a system of surface-contact that they could approve. The installation of the Dolter system resulted, and at first the company were asked to give a guarantee as to its efficient working, but on pressure by the company, this was not insisted on. In return, the company agreed never to put an overhead system on the Torbay Road without the consent of the Council, and further, if required, to adopt an alternative route for any system. The Corporation subsequently gave permission for the construction of the line in Torbay Road on the Dolter system, and as this had failed, instead of taking the alternative route, the company claimed a right to install the overhead system on this road, over which the Corporation had always claimed the absolute control. Having dealt at length with the history of the tramways in Torquay, Mr. Lloyd asked the Arbitrator to say that the Corporation had not been unreasonable in withholding their consent.

Evidence was then continued for the Corporation.

MR. EDWARD LUNTLEY, manager of the Wolverhampton tramways, stating that the Lorain system there had been a success. Witness had been at Wolverhampton since its construction, and had 12 previous years' experience at Birmingham, where they now had the overhead system. Witness much preferred the Lorain system. The cars were steadier, and never lost their lights as with the trolley system. Only one horse had been killed by the studs during the whole time. In the eight years the system had been worked the Corporation had been able to put £32,000 to the reserve fund out of profits.

Cross-examined by MR. KNOX, WITNESS admitted that the expenses of maintenance had risen from ·77d. per car-mile in the fourth year to 1·45d. in the present.

The proceedings were adjourned until noon on Friday. The Arbitrator announced his intention of visiting Torquay on the following Monday to get a personal knowledge of the conditions there.

On the resumption of the inquiry on Friday, MR. COURTHOPE MUNROE, who had been assisting Mr. Lloyd, called further witnesses for the Corporation.

MR. STANLEY CLEGG, M.I.E.E., and the chief electrical engineer to the Lincoln Corporation, said that five years ago the Lincoln Corporation installed the G.B. system in that town after witnessing works on an experimental line there. The system was installed on the following guarantees: (1) Total current not to exceed 1·337 units per car-mile; (2) Total excitation current for magnets not to exceed 480 watts; (3) Number of studs left alive after the car had passed over them, and not recorded by the car indicator, not to exceed 18 per annum; (4) The collection of current to be steady, and judged by the car lights. The great feature of the G.B. system, said Witness, was that a stud could not become alive unless a car passed over it. This was achieved by an earthing strip connected with the rails which carried off the current. These guarantees had been carried out, as the total current consumption per car-mile during the first year's working was 1·075 units, the excitation current for magnets only 260 watts, while in the whole five years not one live stud had been left undetected by the car. There had not been an accident through live studs since the line started to work. The working expenses per car-mile in 1910 were ½d. per mile lower than on any other tramway system in England. Witness considered the system quite as satisfactory as the overhead, and it had the advantage over the latter of quiet running while it preserved the sightliness of the streets.

In cross-examination by MR. VESEY KNOX, WITNESS agreed that there were no curves on the Lincoln track which would make a material difference. Neither were there hills, which would mean less consumption of current. Witness admitted that the number of live studs detected by the cars was increasing, and that the cost of the maintenance of the system had gone up every year, although it had not exceeded an estimated average which had been calculated as over a period of 10 years.

MR. WILLIAM MORRIS MORDEY, of the firm of Mordey and Dawbarn, consulting engineers, Westminster, said he advised the original Dolter Co. on their system. He had assisted the L.C.C. in the investigation of the G.B. system in London, and in July last he investigated the Dolter system at Torquay for the Torquay Corporation. He was asked to ascertain if the Dolter system could be made satisfactory, and if, failing that, any other system of a surface contact tramway would be satisfactory. He answered both questions in the affirmative. Witness was surprised to find the Dolter system working so well at Torquay; the only complaints seemed to be as regards the blinking of the lights and a good deal of trouble in the upkeep. As regards the public use of it, the system was very nearly a complete success. Most of the troubles were caused by the inner pot, and Mr. Mitchell's system did away with the inner pot, and also modified the upper contact surface. At present the contact surface parts were so complicated that they readily got out of order and the magnetism carried by the car was at times unable to attract the switch lever in the pot. Mr. Mitchell had invented a more powerful magnetic arrangement so that the skate on the car did not have to touch the studs; its mere proximity to the studs, with this greater magnetic power, would attract the switch lever without the necessity of running on the studs. Features of the new invention were a longer lever, a longer break between the contacts, and that the contacts could be easily lifted out of the pot to see if they were in line, new carbons put on, and the pot cleaned out. Witness produced a sample of oil which he said was used at Hastings, and which he got from Mr. Mitchell. This oil was for use in the new pot, and was 9 per cent. heavier than water, and 6 per cent. heavier than salt water. He had not tested it for acid, but if acid were present it could be removed. Dealing with his report to the Torquay Council on the defects of the Torquay system, and the improvements suggested by Mr. Mitchell, Witness said he had divided the report into two heads, dead studs and live studs. One cause of the former was the vibration of the stud pot, caused by traffic, thus breaking the electric contact, and actually in some cases the pots themselves. With Mr. Mitchell's new pot the vibration would be less. Carbonisation of the oil would occur less readily, and if it occurred, or the Mitchell pot contained five times as much oil as the present ones, the carbonisation would take longer. The brass cups fixed on the top of the inner pots now became loose, and the inner vessel got out of position, with the result that the contact faces did not come opposite one another, and there was chattering which formed arcs and caused carbonisation. In Mr. Mitchell's invention the contacts were carried on one block, and must come opposite each other. The thick oil from the outer vessel got into the inner and interfered with the switch, but Mr. Mitchell's single pot would contain all thin oil, and was supplied with a more powerful action for the lever, which was thus less likely to be affected. Dealing with the causes of live studs in the present system, witness said one cause was that water accumulated in the outer vessel, got into the inner, and destroyed the insulation. The removal of the inner pot lessened the tendency to insulation. The surface leakage might maintain small arcs in the inner vessel

after the car had passed, and the carbonisation of the oil would be rapid. This trouble would disappear with the one large pot, as by experiment witness had proved it almost impossible to maintain an arc in the larger space. There was no disadvantage in getting rid of the inner pot, but it seemed at one stroke to get rid of a lot of difficulties. Mr. Mitchell offered in July last to relay the Torquay tramway track with his system at £590 per mile of single track, containing 586 studs per mile, and to maintain the track at ·22d. per car-mile on a basis of 370,000 car-miles per annum. Witness, continuing, expressed the opinion that leakage of electricity on the Torquay system was not at all unusual. One always expected a loss in transmission of 10 per cent., and it was only 11·94 at Torquay. The L.C.C. conduit system showed a much larger leakage than any surface contact system. He did not think the charge for electricity at Torquay, which had been given as 1·57d. per unit, was a high charge. He had averaged the charges in several other towns the size of Torquay, but where fuel was cheaper, and the price worked out at 1·44d. per unit. Even in bigger towns like Blackpool, South Shields and others, the average was 1·33d. per unit.

Mr. Vesey Knox, cross-examining, suggested that if the magnetising power of the skid was increased the contact would not be broken before the indicator at the end of the car got to the stud, and a live stud would thus be always indicated. Witness said this could be got over by reducing the surfaces of the contacts. Witness had never made an experiment with the oil he got from Mr. Mitchell. He agreed that, to get a proper oil was the gist of the whole matter. He did not agree with Mr. Swinburne that there was no satisfactory oil. He believed the one now referred to would be satisfactory.

Pressed as to the non-success of the Dolter system at Mexborough, Witness replied that there must have been something very wrong with its management. He was aware that Mr. Mitchell laid that system down. He did not believe that Mr. Mitchell's new invention for so placing the brush under the car that it could not fail to record a live stud, was really tested at Torquay.

Mr. Vesey Knox (after consulting Mr. Holliday, the Torquay manager), said the invention was tried in Mr. Mitchell's presence—and it was now on the scrap-heap.

The Arbitrator said that what struck him was that Mr. Mitchell had been bringing out patents to perfect this surface-contact system ever since 1907, and here they were, in 1910, in the same position, although Mr. Swinburne had told them that a man who could perfect the system would make a fortune. If Mr. Mitchell's inventions were really practical, why had not they been adopted?

Mr. Courthope Munroe said there were not many people using the system to experiment with patents. The system was only in use in Mexboro', Hastings and Torquay by the Dolter people.

Mr. Mordey continued his evidence, and Mr. Vesey Knox said he understood that Mr. Mitchell's method of swinging the brush, so that it would always indicate a live stud, failed because the bell was continually ringing owing to the skate and brush being on an insulated rail at the same time.

Witness: Exactly, it indicated the insulated rails. Witness was still of opinion that the G.B. system was a good one. Mr. Knox reminded him of the Mile End Road fiasco, and Witness dryly admitted that the L.C.C. had disregarded his advice that the stud system should be improved and maintained there.

Witness was briefly re-examined by Mr. Munroe, his evidence having occupied four hours.

The inquiry was then adjourned until the following morning.

On Saturday the first witness was Mr. Frederick Samuel Hex, the Town Clerk of Torquay since the incorporation of the borough in 1892. He outlined the history of the installation of the Dolter system. A committee of the Corporation first visited Paris and Wolverhampton and witnessed the working of the Dolter and Lorain surface-contact systems respectively, and decided to approve the construction of the former system. In the result the Dolter Co. obtained their Bill of 1904. The line was constructed in parts, the first being tramway No. 1, which ran through the centre of the town. The Dolter Co. were asked to guarantee the efficient working of their system, but this was not agreed to, and the Corporation gave up the guarantee for the double option of reserving to themselves the right to veto any overhead system on the Torbay Road, or to demand an alternative route for any system. Witness expressed the opinion that the running of the service was satisfactory. The cars ran very quietly, the gradients were taken well, and the whole service was "in striking contrast to the running of overhead trams." The Corporation were quite satisfied with it as regards the service to the public, but they were continually pressing the company to make improvements in the actual system so as to satisfy the Board of Trade. The company's reply generally was that they had not the money to spend on improvements, and it was because of the company's representations that the extension of the line to Paignton would bring in more income, to be devoted to improvements, that this was allowed. Witness went at length into the correspondence that had taken place between the Corporation and the company on the subject of improving the system, and read minutes of two Committee meetings of the Council in connection with the matter. At one meeting the Committee recommended the Council to allow the company to install the overhead system on the whole of the route with the exception of the Torbay Road, and to even allow the overhead system to be used on Torbay Road provided the company would undertake to construct a special linking-up system, extending the present system, within the course of three years from August, 1910, under a penalty equal to the cost of construction. A letter was written to the company embodying these proposals, but the company refused to entertain the idea on the ground that they had not the funds to make such an extension.

In cross-examination, Mr. Knox read extracts from a local newspaper report of a Torquay Council meeting, showing that Councillor Pike (the chairman of the Committee in charge of the tramway negotiations), stated that he was in favour of an overhead system on Torbay route, and that it would be absurd to work this small piece of line on a different system to the rest of the route. Witness admitted that there were meetings of ratepayers held to force the Corporation's hand in allowing the construction of tramways in Torbay Road. The company spent £5,000 in wood-paving the whole width of the roads on the Torbay route.

Col. Spragge, the Mayor of Torquay, said the Tramway Committee by only a small majority, made the offer to the tramway company about the overhead system in Torbay Road in return for the construction of another route. He believed the consideration of the overhead system in Torbay Road would be disadvantageous to the town.

By Mr. Knox: Witness had objected to any system of tramways in the town at all. If a poll were taken in favour of an overhead tramway system in Torbay Road, witness would still not agree with the project.

Councillor Pike said he represented a working-class ward on the Torquay Council, and was chairman of the Committee dealing with tramway affairs. His own view was that rather than not have any tramway at all on the Torbay Road they should, as a last resort, allow the company to construct the overhead system. He believed, however, that the majority of the inhabitants would not agree with him.

Mr. John Taylor, an ex-Mayor of Torquay; Mr. Lelieu, managing director of the Torbay Hotel; and Mr. Flatt, a boarding-house keeper in the Torbay Road, all gave evidence to the effect that the overhead system in Torbay Road would deter visitors from staying there.

Mr. H. A. Garratt, the Torquay surveyor, said it was not correct that the roads were watered with salt water, as had been stated. He considered that if the company had paid as much attention to the system during the past two years as they did in the first year, the result would have been far more satisfactory.

Mr. Vesey Knox then summed up at length for the company. He pointed out that the inquiry had not originated in any act of the company, but was due to the Board of Trade, an impartial outside authority, considering that the present system was unsafe, because of faults which were found from the beginning, which had been found throughout, and which no amount of expenditure could remove. He contended that Sec. 61 of the Company's Tramways Act of 1904 was specially put in that Act, and all such Acts, because of the great abuses that had arises through Corporations withholding reasonable consent in the matter of public undertakings by companies. He submitted that the matter of the cost of the system had a most important bearing on the question of reasonableness. He quoted as an analogous case arbitration between the Postmaster-General and the Croydon Corporation. There the local authority sought to compel the Post Office to put the wires for a telephone system underground, but the arbitrators ruled against the Corporation because of the great expense of so doing, as compared to putting the wires overhead. If expense was to be considered in the matter of the Post Office, it must be a stronger argument still in the case of a company such as he represented, which had no money to spend. There could be no doubt from what had taken place in the Committee of the Torquay Council, as shown by the minutes, that the Council were prepared to sanction the overhead system all over Torquay, and in the Torbay Road, if the company would construct certain lines the Council required. Such lines would run parallel with existing lines and take traffic off existing routes. Anyway the company refused to be bled any further (they had already spent £51,000 in wood-paving on the Torbay Road), and the Corporation then said "because you won't give us what we want, you shan't have a yard of overhead line in Torquay." Counsel proceeded to argue that there was no suitable system of tramway for Torquay but the overhead system. Any adaptation of the Dolter system was out of the question. They had 37 men on five miles of line in the first year of working to look after the studs, and at the end of that time the Board of Trade would only give a provisional sanction. They had tried five separate inventions of Mr. Mitchell, and spent £30,000 in trying to perfect the system. He ventured to say, in spite of any expert opinion, that the Dolter system had absolutely failed. Even Mr. Mordey did not try to set up the Dolter system, but suggested a variation of it. Everybody agreed that the great difficulty was the water getting into the pot, and now they were actually told they could get rid of the trouble by taking away the inner pot, which had a lid, and substituting a pot filled with only thin oil, which was to have no protection or covering at all. He thought the suggestion ludicrous.

Counsel proceeded to deal with the Lorain system, which, he said, was much too expensive to be practicable at Torquay, and the G.B. system, which was a proved failure, and asked the Arbitrator, in conclusion, to say that the overhead system was the only possible one, and that the Torquay Council must therefore assent to its construction.

The proceedings then terminated.

Loch Leven Valuation Appeal.

The Loch Leven Water Power and Electric Co., Ltd., figured prominently in the list of appeals heard before the Argyleshire Valua-

tion Appeal Court at Oban last week, the sum appealed against being £35,000. Last year the Court fixed the valuation at £30,500, this being 5 per cent. of the total admitted capital expenditure; as the works, however, were not completed at August 12th, the valuation for the year was restricted to £10,170. The principle established then of taking 5 per cent. on the total capital expenditure had been again adopted by the assessors, the result being a valuation of £35,000. This, however, they were willing to restrict to £32,000 on an adjustment with the appellants of the total capital expenditure up to date. On behalf of the company it was claimed, however, that they should be rated on the year's profits. The Court, in their decision, stated that in fixing last year's valuation they had adopted the only method then known to them, a percentage on capital outlay. During the past 12 months the profit, as represented to them, amounted to £20,450, against which certain figures were set which more than absorbed the profit. Comparing the last six months with the first six months, the Committee were of opinion that the prospects for 1910-11 showed better than for the year ended on May 15th last, and therefore felt justified in concluding that the current year would be more successful. They fixed the sum of £7,500 as a fair assessable value, which sum compared with a rate of approximately 1½ per cent. upon the capital expenditure of the works.

The assessors asked for a stated case to be laid before the Court of Session.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Sealing-In Machine.

The accompanying illustration shows a sealing-in machine which The Foster Arc Lamp and Engineering Co., Ltd., Morden Road, Wimbledon, are using in their own works for the manufacture

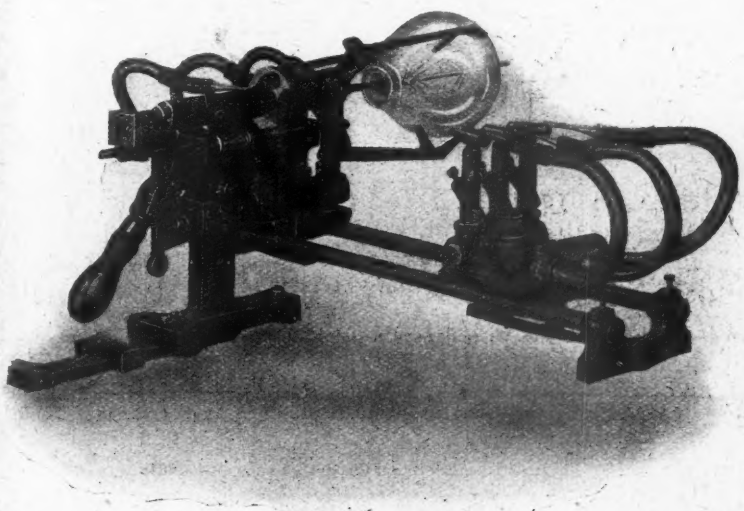


Fig. 1.—Sealing-in Machine.

of the Foster metallic-filament lamps, and are also placing on the market. The machine greatly facilitates the work, and reduces the risk of breakage of filaments to the minimum, while the central support which carries the filaments is always held truly central. When the lamp frame is removed, the gas flame is at once automatically lowered.

Leading-in Insulators.

When connecting rubber-insulated lead-sheathed wires or cables to an aerial line, a leading-in insulator is necessary on account of the conducting properties of the lead sheath. A new type of insulator for this purpose has been introduced by Dr. Alfred Steinbuch, and is being put on the market by Messrs. G. Bihl & Co., whose London agent is Mr. Archibald Campbell, of 27, Chancery Lane, W.C., the makers' representative for Great Britain and the British Colonies. The principles which have been observed in evolving this insulator are the following:—The petticoat must be proof against the action of moisture and corrosive matter in the atmosphere, and must be connected to the rubber insulation by a damp-proof joint; metallic parts must be avoided; wiring must be easy, and the insulator as a whole must be simple and easy to repair.

The device fulfilling these requirements is shown in the accompanying illustrations. Fig. 3 is a section of the insulator, which consists of a porcelain bell C, with a curved neck provided with two bosses G; inside there is a perforated plug D of insulating material, which can be compressed upon the rubber sheathing E of the conductor H by a screwed porcelain stopper B, slipped over the lead sheathing A. It will be seen that the device practically embodies a stuffing-box and gland, making a stanch joint between the insulator and the rubber. As issued, the insulator is provided with an iron pin inserted in place of the cable, to keep the passage clear and

Fig. 2.—Steinbuch Insulator in Position.

facilitate the insertion of the conductor. It is attached to the aerial wire by means of a tinned-copper wire F wound round the neck and soldered, with long ends which are twisted round the aerial wire J after the insulator is placed in position as in fig. 2, making a secure fastening. When the aerial wire is vertical, a clamp with a

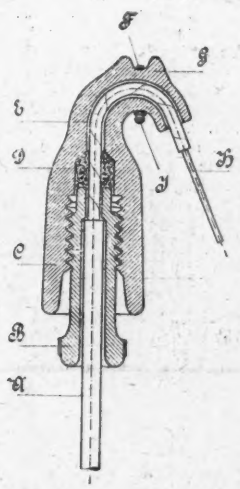


Fig. 3.—Section of Steinbuch Leading-in Insulator.

horizontal arm is attached to the line insulator, to support the leading-in insulator. Tests extending over long periods have proved the insulating power of the device, which even under the worst conditions is extremely high. Large quantities of these insulators have been supplied to the Australian Government, and they have been adopted by the Austrian telegraph authorities after exhaustive trials.

Sketching Set-Square.

An ingenious device, invented by Mr. J. H. Holmes, of Newcastle-on-Tyne, is being put on the market by Messrs. J. Halden & Co., Ltd., 8, Albert Square, Manchester; it consists of a celluloid set-square, ruled with lines and scales as shown in the figure, which

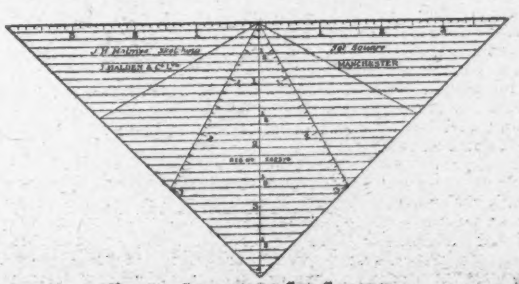


Fig 4.—Sketching Set-Square.

enable it to be used as a straight edge, parallel ruler, scale, protractor, and set-square with 8 angles. It is likely to be especially useful in conjunction with sectional paper, or for hand-sketching with a manifold carbon copybook or sketch block. Any draughtsman will see at a glance how to use it for most of the purposes above indicated; it is made in several sizes, the smallest of which can be carried in the waistcoat pocket. The lines are ruled upon the under side of the square, so as to avoid parallax.

Three-Pin Plug and Socket.

The accompanying illustration shows a new "fool-proof" three-pin plug which has been introduced by the British Central Electrical Co., of 84, Hatton Garden, E.C. As shown, the plug is of the "Handshield" type in accordance with the Home Office Regulations, and the third pin is so placed that it is impossible to insert the plug in the socket, except in the correct position. The

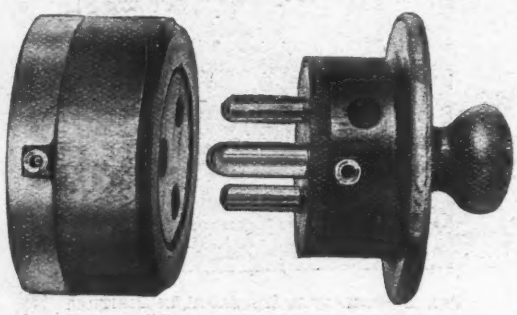


Fig. 5.—"Handshield" Three-pin Plug.

third pin is also longer and thicker than the others, so that no contact can be made with the wrong terminals, and the contacts in the socket are deep below the surface of the latter. A noteworthy feature is the provision of visible earthing terminals on the plug and socket, rendering a mistake in wiring them most unlikely. The device appears to be admirably adapted for use where an earthing wire is necessary.

New Metal Framing.

A new type of metal framing for expanded metal, wire work, &c., for doors and screens, is being placed on the market by Messrs. S. Wheeler, Ltd., Soho Boiler Works, Smethwick, who are the patentees and sole makers. The device, which is the invention of Mr. H. C. James-Carrington, of Birmingham, is illustrated in fig. 6, which shows a group of typical sections; A and B are simple sections for the doors of switch-boxes, cupboards, &c.; C is useful for folding doors and similar purposes, and D is suitable for building

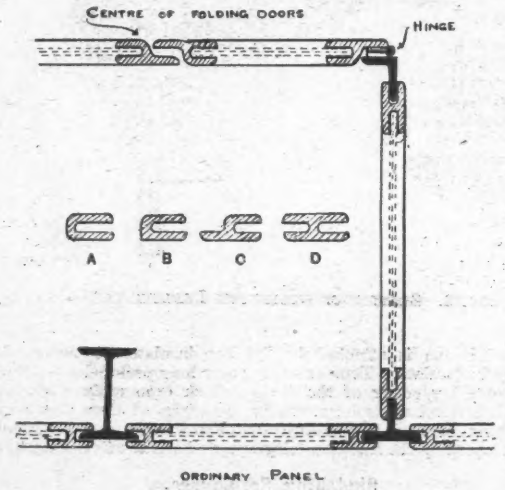


Fig. 6.—Metal Framing for Screens, &c.

up continuous screens. The expanded metal or wire work is put between the flanges on the inside, and the outer flanges are available for slipping over the angle or tee-bars, channels, &c., of which the framework of the building is constructed, giving secure fixing without bolts. Extensions and alterations are readily carried out with this framing, which is also entirely fireproof and indestructible. The illustration shows some of the ways in which it can be applied. The frames are made with solid corners, notched to facilitate bending, and the expanded metal is held in place by rolling the flanges down on to it.

Cookstown Lighting.—The Council has decided to have an electric lighting scheme for the town, and is in communication with a local manufacturing firm to supply the power.

BRUSSELS EXHIBITION.

(*Continued from page* 452.)

The list of awards to exhibitors has now been issued, and it is found that the British exhibits have been highly appreciated, judging by the results of the jury's labours. We offer our congratulations to the following firms among those thus honoured:—

Kelvin and James White, Ltd., Glasgow, Classes 15, 23, 27 and 123, Grand Prix; Class 33, Diploma of Honour.

Negretti & Zambra London Class 15, Grand Prix; Class 74, Gold Medal.

Reflector Syndicate, Ltd., London, Class 23, Grand Prix; Classes 15, 24, 31, 33, 73, 75, 122, Gold Medal; Class 87, Silver Medal.

Gambrell Bros., London Class 27, Diploma of Honour; Class 15, Silver Medal.

E. Green & Son, Ltd., Wakefield, Class 19, Grand Prix.

J. Hopkinson & Co., Ltd., Huddersfield, Class 19, Grand Prix; Class 33, Diploma of Honour.

Marshall, Sons & Co., Ltd., Gainsborough, Classes 19 and 35, Grand Prix; Class 20, Gold Medal.

J. and H. McLaren, Leeds. Classes 19, 21 and 35, Grand Prix; Class 28, Bronze Medal.

Ruston, Proctor & Co., Ltd., Lincoln, Classes 19, 28, 35, Grand Prix; Class 20, Diploma of Honour; Class 21, Gold Medal.

Underfeed Stoker Co., Ltd., London, Class 19, Diploma of Honour; Classes 74, 87, Silver Medal.

G. and J. Weir, Ltd., Glasgow, Classes 19, 21, Diploma of Honour; Class 122, Gold Medal.

Holden & Brooke, Ltd., Manchester, Class 33, Diploma of Honour; Class 19, Gold Medal.

National Gas Engine Co., Ltd., Ashton-under-Lyne, Classes 19, 20, Gold Medal.

Sturtevant Engineering Co., Ltd., London, Classes 19, 21, Gold Medal.

Crossley Bros., Ltd., Manchester, Class 20, Grand Prix.

Campbell Gas Engine Co., Ltd., Halifax, Class 20, Grand Prix.

Reavell & Co., Ltd., Ipswich, Class 21, Diploma of Honour; Class 20, Bronze Medal.

Appleby Crane & Transporter Co., Ltd., Glasgow, Class 21, Grand Prix.

Waygood & Co., Ltd., London, Classes 21, 23, Grand Prix; Class 66, Silver Medal.

Marryatt & Place, London, Classes 21, 23, Diploma of Honour.

Lacy, Hulbert & Co., Ltd., London, Class 21, Gold Medal.

Morgan Crucible Co., Ltd., London, Class 23, Grand Prix.

Hon. C. A. Parsons & Co., Newcastle-on-Tyne, Class 23, Grand Prix.

Lancashire Dynamo and Motor Co., Ltd., Manchester, Class 23, Gold Medal.

John J. Griffin & Sons, Ltd., London, Class 87, Diploma of Honour; Classes 24, 74, Gold Medal; Class 15, Silver Medal.

Faraday & Sons, London, Class 97, Diploma of Honour; Class 25, Gold Medal.

Ropley, London, Class 25, Gold Medal; Class 75, Silver Medal.

J. Dugdill & Co., Manchester, Classes 25, 75, Bronze Medal.

R. W. Paul, London, Class 27, Grand Prix.

Nalder Brothers & Thompson, Ltd., London, Class 27, Diploma of Honour.

Synchronome Co., London, Class 27, Diploma of Honour.

Fowler & Co., Ltd., Leeds, Class 35, Grand Prix; Class 28, Gold Medal.

Mavor & Coulson, Ltd., Glasgow, Class 63, Gold Medal.

British Aluminium Co., Ltd., London, Class 64, Grand Prix.

Doulton & Co., Ltd., Burslem, Class 72, Grand Prix.

Johnson, Matthey & Co., Ltd., London, Classes 87, 111, Grand Prix.

The Cambridge Scientific Instrument Co., Ltd., Cambridge, was placed *hors concours*.

The new British Section was formally opened on Monday last by the King of the Belgians, who heartily congratulated all who were concerned in this remarkable achievement. It is most gratifying to record that no fewer than 200 of the British exhibitors accepted the invitation of the Exhibitions Department of the Board of Trade to renew their exhibits, on the shortest notice; unfortunately it was not possible to accommodate so large a number in the Salle des Fêtes, which was eagerly placed at the disposal of the British Commission by the Belgian authorities, but some 180 firms are represented by exhibits of manufactures, and others by photographs, &c. Working at high pressure, the participants have succeeded within one month in organising a British Section inferior only to its ill-fated predecessor, and have given to the world an example of courage and resource which cannot fail to have its effect upon the nations. The utmost praise is due to all who have contributed to the success of the new Section; may their reward be as ample as it is well merited!

The Ateliers de Constructions Electriques du Nord et de l'Est, of Jeumont, have a large and varied exhibit of electrical machinery and cables in the French Section, as well as a three-phase compound turbo-alternator of 1,500 kw. in the Machinery Hall. The latter, which is illustrated herewith, is driven by a Dujardin turbine, and supplies current to a group of exhibitors at 10,000 volts, 80 cycles, 1,500 r.p.m. The Latour system of compounding is employed, in which the exciter is a compensated series dynamo working on a

straight part of its characteristic, so that the pressure is theoretically indeterminate; the essential feature of the system is that if, by means of an external source of current, the proper pressure is "indicated" to the exciter, the latter will of itself assume that pressure, without deriving an appreciable amount of power from the external source. This end is attained by providing the armature with slip-rings fed from a three-phase pressure transformer, of

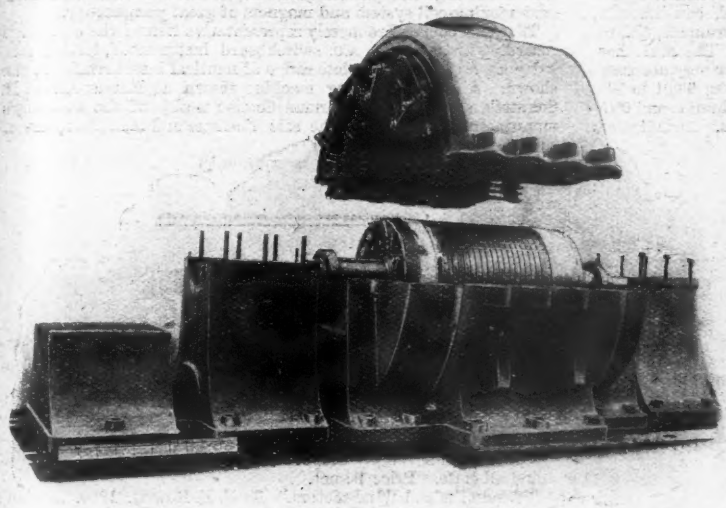


Fig. 33.—Three-phase 1,500-kw. Turbo-Alternator.

which the primary is connected to the terminals of the alternator; in series with the leads are the secondaries of current air-gap transformers with primaries in series with the generator load. On light load the alternator assumes a stable condition in which the exciting current develops at the slip-rings a pressure exactly equal to that of the pressure transformer, taking practically no current from the latter; on load, the exciting current is increased by the effect of the current transformer to compensate for the losses in the generator. The terminal pressure is easily adjusted by shunting the fields of the exciter more or less, and as the transformers have very little to do, they can be made very small. The Company has made a speciality of the construction of A.C. commutator motors, of which several types are shown. These include a Latour series motor for 130 volts, 50 cycles, of 22 H.P., the commutator of which is provided with equalising conductors, ensuring good commutation over a range from 550 to 1,100 R.P.M.; another is a Latour traction motor of 60 H.P. at 400 volts, 25 cycles, with a power factor of 0·9, the weight of the machine being 1,200 kg. Fig. 35 shows one of a series of small single-phase motors (3 to 7 H.P.) for electric lifts; these start as Latour series motors with a torque of 3½ times the normal, and on approaching synchronism an automatic device switches on a shunt excitation which maintains constant speed. If these motors are run at speeds above the normal, they restore power to the mains. The power factor is at all loads almost exactly unity; the commutation at starting is very satisfactory, and on load it is claimed to be perfect. A Rateau pump made by the company is driven by a three-phase series commutator motor, with speed regulation by shifting the brushes, shown in fig. 36. One of the traction motors exhibited has to develop 50 H.P. in a climate where the temperature reaches over 120° F. in the shade, necessitating special precautions to reduce the heating by every possible means.

The apparatus employed for the Sprague-Thomson multiple-unit system on the Metropolitan Railway of Paris forms a prominent feature of the exhibit, all the parts being displayed on a large panel. Fig. 34 shows a large three-phase circuit-breaker for 10,000 volts, of very substantial construction; it is controlled by direct current from a distance, through the agency of the closing solenoid A and the opening solenoid B.

The remaining exhibits include samples of cables of all kinds; one of these is a three-phase 15,000-volt cable which has been in use for two years on a duplicate line 30 km. in length. The company shows telephone cables of 800 conductors, mining cables, and cables with aluminium conductors, as well as material and accessories for mains work, electrical installations, &c.

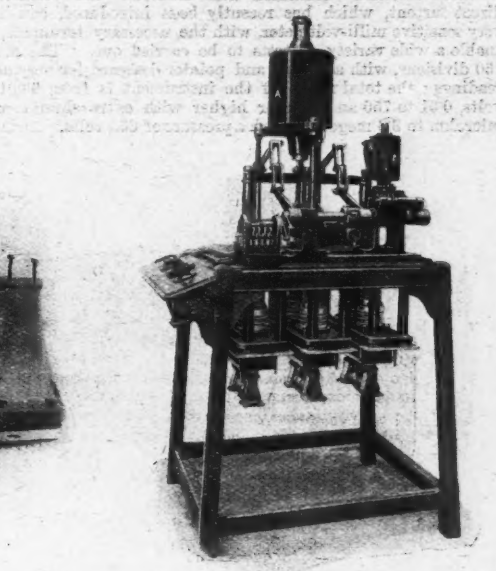


Fig. 34.—Three-phase 10,000-volt Circuit-Breaker.

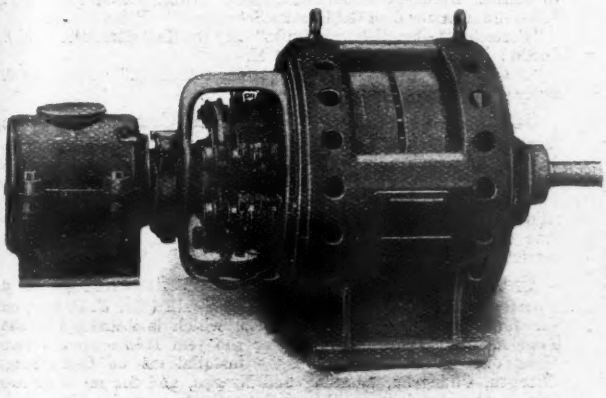


Fig. 35.—Latour Single-phase Motor.

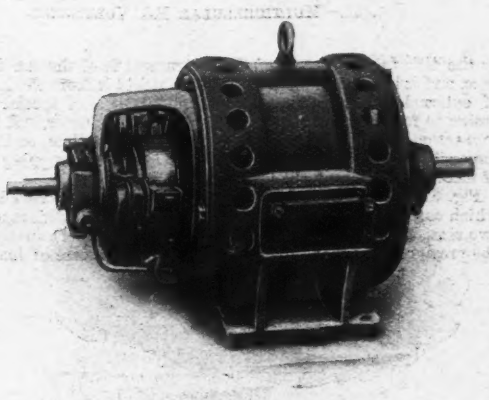


Fig. 36.—Three-phase Motor.

Exhibits of the Ateliers de Constructions Electriques du Nord et de l'Est.

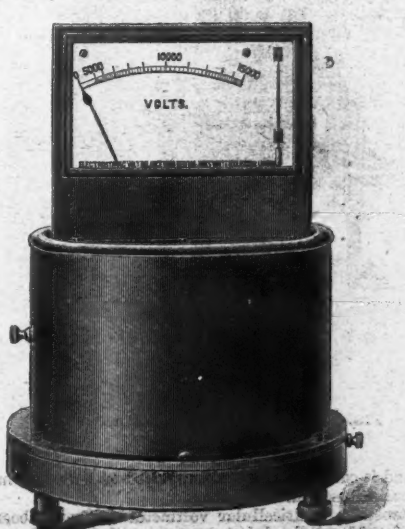


Fig. 37.—Kelvin Electrostatic Volt Balance.

Messrs. Kelvin & James White, Ltd., of Glasgow, had a large and varied exhibit of their instruments, which unfortunately was destroyed with the rest of the British Industrial Section. The company, however, have lost no time in renewing their exhibit, which has now been completed, in time for the re-opening of the new British Section. From the numerous items of interest we have selected the following for notice:—

"Lord Kelvin's" combined S.R. ammeter and voltmeter for direct current, which has recently been introduced, consists of a very sensitive milli-voltmeter, with the necessary terminals, &c., to enable a wide variety of tests to be carried out. The scale has 150 divisions, with a mirror and pointer designed for very accurate readings; the total range of the instrument is from 0·001 to 600 volts, 0·01 to 750 amperes, or higher with extra shunts, and 0·65 microhm to 3·3 megohms with a pressure of 600 volts. As indicated

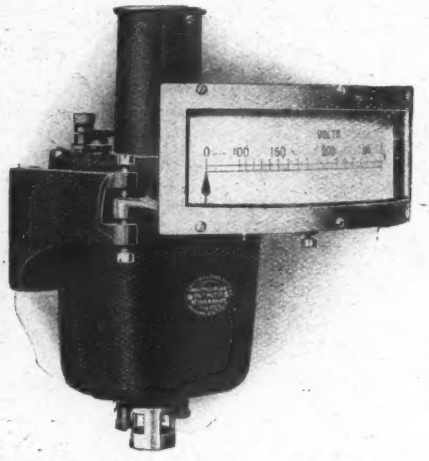


Fig. 38.—Multicellular E.S. Voltmeter.

by the title (siphon recorder) the instrument is of the moving-coil type, and it is fitted in an iron case to shield it from the influence of external fields. The shunt terminals are of special patent design to facilitate connection to any size of conductor, and the live connections are covered with the vulcanite cover plate, so that it is impossible to make a short-circuit by accidentally dropping a piece of metal on the top of the instrument while in use.

Fig. 37 shows a special small type of electrostatic volt balance, which can be used for pressures up to 30,000 volts; this is made in two sizes, the one illustrated being a portable pattern intended for the pressure testing of cables. It is fitted in a case of insulating

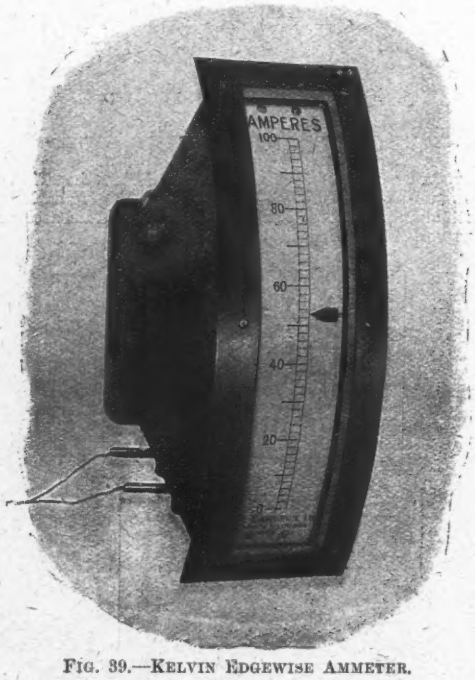


Fig. 39.—Kelvin Edgewise Ammeter.

material, and is carried in a box supported on porcelain insulators so that it can be used inside the box.

An electrostatic multicellular voltmeter for switchboard use is shown in fig. 38, of the latest pattern; these instruments are specially useful as permanent checks on the accuracy of other voltmeters on a switchboard, being unaffected by temperature, magnetic fields, wave form and frequency, and consuming an inappreciable amount of energy. The range can be extended by the addition of a "multiplier."

One of the various designs of Lord Kelvin's S.R. (moving coil) ammeters and voltmeters for direct current is shown in fig. 39. This is the edgewise pattern ammeter, in cast-iron case, with dead-beat moving-coil system and magnets of great permanency.

These, of course, are merely representative items; the company's recording instruments, A.C. switchboard instruments, testing sets, balances, &c., and a complete range of nautical instruments are also shown. A pattern-making machine shown at Messrs. Alfred H. Schutte's stand in the German Section is also of the company's manufacture, they being the sole licensees and manufacturers of this machine.

(To be continued.)

BUSINESS NOTES.

Book Notices.—"Solenoids, Electromagnets and Electromagnetic Windings." By C. H. Underhill. 1910. London: Constable & Co., Ltd. Price 8s. net.

"The Record of the Special Commission formed by the British Fire Prevention Committee to visit Berlin, Hamburg and Hanover." London: The Office of the Committee. Price 5s.

"Motor-boats Simply Explained." 1910. London: Percival Marshall & Co. Price 1s. net.

"Windmills and Wind-motors." By F. E. Rowell. 1910. London: Percival Marshall & Co. Price 6d. net.

"*Prospectus* of the South-Western Polytechnic." 1910-11. Price 1d. London: The Polytechnic.

"Nautical Technical Dictionary for the Navy." Part II, L-Z. In English, French, German and Italian. 1910. Pola (Austria): "Mitteilungen aus dem Gebiete des Seewesens." Price 16s. 8d.

"Fortschritte der Elektrotechnik." By Dr. Karl Strecker. 1910. Berlin: Julius Springer. Price 15 M.

"*Bulletin* of the Société Belge d'Electriciens." July, 1910. Brussels: Ramelot Frères.

Outing.—The employés of the Peel-Conner Telephone Works, Salford, Manchester, had a pleasant outing on Saturday last. In ideal weather they went by motor char-a-banc to Whaley Bridge and back, and for a ramble through the woods in the vicinity. Tea was provided at the Royal Oak, Taxal, after which the party adjourned to the hotel and made merry with music and song. A vote of thanks was accorded to Mr. T. James, who successfully carried out the arrangements.

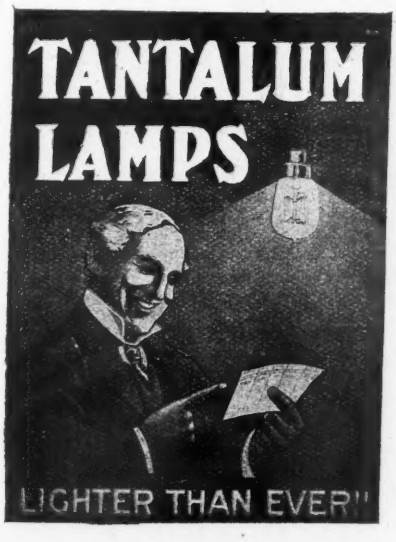
Electrical Installation Progress in China.—In a report of H.M. Commercial Attaché at Pekin (Mr. W. P. Ker) on the foreign trade of China in 1909, which is abstracted in the *Financier*, it is stated that "during the year 1909 contracts were given out for new electric light installations at Chungking, Chengtu, Changsha, Nanking and Ningpo, and for more or less important extensions at Shanghai (settlements and native city), Hankow, Pekin, Swatow, Mukden and other places. Negotiations were proceeding at the beginning of 1910 for a large installation at Hangchow and for installations in several cities in Manchuria. Indeed, there may be said to be an electric lighting project in every city in China (although at Pakhoi the project is stated to have been abandoned in view of the successful introduction of incandescent gas mantles); the only difficulty is to find funds for carrying such projects into execution. Almost all contracts require to be financed by the contractors, and British firms, finding British manufacturers unwilling to supply plant except for cash down, have sometimes co-operated with German firms, the latter arranging the finance in return for being allowed to participate. Thus, several of the contracts mentioned above are for British engines and boilers, and German dynamos. Payment is generally spread over a period of two or three years on proper security being given. In further illustration of the progress in electrical works, it may be mentioned that an electric tramway scheme for Canton is under contemplation, that a considerable extension of the telephone system in that city has recently been carried out, and that preparations are being made for inaugurating telephone services at Chengtu, at Wuhu, and in the provinces of Kiangsi and Chekiang. The remarks made above with regard to electric lighting schemes apply also to waterworks, for which there are many projects, perhaps still more difficult to finance. Waterworks are in operation in Shanghai, Hankow, Tientsin, Canton and Pekin, and there are unrealised schemes for Nanking, Chinkiang, Hangchow, Swatow, Newchwang, Tsinan, and probably several other cities. A waterworks system which was started in Chengtu in 1906 has proved a failure."

Switchboard Contracts.—The Lyme Regis Electric Lighting and Power Co., Ltd., has accepted the tender of the Walsall Electrical Co., Ltd., for extensions to its main switchboard. The same firm's tender has been accepted by the Earl of Dudley's Round Oak Works for one main generator and feeder switchboard.

Swedish Trade.—A Swedish engineer who is leaving for Sweden is open to serve manufacturers desirous of pushing their goods there. See our advertisement pages to-day.

Private Meeting.—J. C. Sudall and Edgar John Heap (trading as Sudall & Heap), South Shore, Blackpool, electricians.—A meeting of the creditors in this matter was held last week when a statement of affairs was presented showing liabilities £309, all of which were in respect of trade debts. The assets totalled £246. After deducting £29 for preference claims, the net assets amounted to £217, the estate thus showing on paper a deficiency of £92. It was reported that the debtors had been in business nearly 3½ years, having started trading with a joint capital of £20, divided in two equal shares. The books of account which had been kept were not sufficiently accurate to allow of proper trading or profit and loss accounts being prepared. The household furniture in the case of Sudall is claimed by his wife, and this matter will be further investigated. The other debtor is in lodgings, and therefore has no furniture. The creditors at the meeting last week resolved to confirm the deed of assignment which had already been executed in favour of Mr. Jas. Todd, chartered accountant, of Blackpool.

Tantalum Publicity.—Tantalum lamp advertising has always been distinctive and effective. For the information of contractors and the trade generally, we may state that this year Messrs. Siemens Bros. Dynamo Works, Ltd., Tyssen Street, Dalston, have arranged a wider and more comprehensive scheme than in the past. While their general Press advertising—technical and newspaper—will assist in exciting public interest, a number of specialities are placed at the disposal of contractors and others for distribution amongst their *clientèle*. We reproduce below an illustration of the new design of tantalum lamp show-card, which is one of the "satisfied consumer" series, and is a follow-on to the well-known poster, "My Electric Light Bill Halved." It is of small size, 12 in. × 9 in., printed in five colours, with the main features embossed, the lettering being glazed to make it stand out very prominently. Posters of the same design, size 80 in. × 60 in. and also 120 in. × 80 in., will be supplied to any person who has a suitable space for displaying them. The firm are also supplying a five-coloured card giving reduced facsimiles of all types of literature which they overprint in quantities, with the



contractor's name and address, free of charge. This includes postcards and three or four types of adhesive labels supplied for attaching to correspondence. The picture postcards are printed with the same design, and on the back the contractor's name and address can be overprinted. The adhesive labels are well-known and widely used, and the latest production of the firm in this respect is a cut-out in the shape of a tantalum lamp, which has been lithographed in colours, and on which the words "Use 'Tantalum' Lamps" appear; these are intended for fixing to all outward correspondence. A reprint of the Hassall design, the "Brilliant Passage" stamp, has been obtained, and these will be again supplied during the forthcoming season. A reprint has also been obtained of the Dalston Works adhesive labels, and is available. A very wide scheme of Tube Railways advertising has been arranged. In connection with poster advertising, Messrs. Siemens Bros. have arranged a very extensive programme, and posters will appear on many hoardings in all the large provincial towns, whilst in and around London there will also be a representative display. In conjunction with the foregoing schemes, there are also several special schemes by means of which consumers will be approached direct. The sales of tantalum lamps, which have been steadily increasing during the present year, are expected to receive a further stimulus from this publicity campaign. Contractors are asked to take notice that any of these specialities can be obtained by writing to Messrs. Siemens Bros. Dynamo Works, Ltd., Tyssen Street, Dalston, London, N.E., who control and arrange the publicity matters connected with tantalum lamps and fittings.

Theatre Installation.—With reference to our note under "Contracts Closed" last week regarding the contract for the complete electrical equipment of the Palladium Theatre of Varieties, which has been secured by Messrs. Siemens Bros. Dynamo Works, Ltd., we are informed that the theatre will be lighted throughout by the firm's fittings and tantalum lamps, and the circuits protected by "Zed" fuses. "Stannos" wires have been specified for the wiring, which, as already stated, has been sublet to Messrs. Rashleigh Phipps & Co.

Dissolutions and Liquidations.—The firm of Thomson & Ramsay, consulting engineers, 55, West Regent Street, Glasgow, was dissolved by mutual consent on June 6th last by the retiral of Mr. R. G. Thomson. Mr. Alexander Ramsay now carries on the business for his own behoof under the same name. He will uplift the debts due to, and pay those due by, the dissolved firm.

Mr. W. Hutton, the liquidator of Walter Newbold & Co., Ltd., has sold the goodwill, business and stock-in-trade to Mr. Walter Newbold, who will carry on the business on his own behalf, as Walter Newbold & Co., at 107-108, Upper Thames Street, E.C.

Bankruptcy Proceedings.—T. R. Balshaw, manufacturers' agent, formerly of 111, Farringdon Road, now of 45, St. Mary Axe, E.C.—Bankrupt's application for discharge will be heard on October 12th, at Carey Street, W.C.

J. D. M. Morton, electrical engineer, Mirfield.—First meeting, September 27th; public examination, October 4th, both at Dewsbury.

J. G. S. Cunnington & H. P. Allison, electrical engineers and contractors, 7, Great Newport Street, London.—September 30th is the last day for the receipt of proofs for intended dividend to be sent to the trustee, Mr. A. Page, 28, King Street, E.C.

Alan McAlpin, electrical engineer, Leicester.—October 4th is the last day for the receipt of proofs for intended dividend. Trustee, Mr. L. V. Wykes, 24, Friar Lane, Leicester.

Long-Lived Lamps.—A user of the electric light in Doncaster states that, three years ago, his installation was put in with tantalum lamps, of which 10 are in constant use. Up to the present only two new lamps have been required, and the lights are as good as ever. Assuming that the two lamps had an average life of 1½ years, the average life of the 10 is evidently at least 2·7 years, and may be much longer,

Trade Announcements.—Messrs. Pooley & Austin, 25, Victoria Street, S.W., ask us to state that, as sole London agents for Messrs. Frankenburg & Sons, of Manchester, they are now holding a stock of the usual sizes of rubber cables, in order to give prompt delivery in this district.

Mr. Parry Mell, A.M.I.E.E., is shortly opening motor garage and electrical works at 34, The Parade, Leamington Spa. He wants to get into touch with electrical manufacturers and suppliers.

Messrs. Vaughan Engineering Installations, Ltd., of Goswell Road, E.C., announce that Mr. T. W. Vaughan, who has for the last year acted as their works manager, has now no connection with the company.

The Victa Electrical Co. have removed their works and offices to larger premises at 60, Queen's Road, Battersea, S.W.

Messrs. Croft & Perkins, Ltd., power transmission engineers, Bradford, Yorks., have appointed Messrs. Frank R. Cerrito & Co., Exchange Buildings, Stevenson Place, Birmingham, as their agents for Warwickshire, Staffordshire, Worcestershire and Shropshire.

"Lux" Candles for New York.—We learn that the Lux Candle Co., of 240, High Holborn, W.C., have just shipped to New York all the electric candles required for the new Carlton Ritz Hotel in that city. Lux candles were selected on their merits as being specially suitable for the ugly screw holders used in America. The candle covers the holder, and so makes a perfect joint on the candle cup.

Catalogues and Lists.—Messrs. Sanders, Rehders and Co., 108, Fenchurch Street, E.C.—The first three numbers of the "Sarco" Bulletin, in which from time to time the firm publish interesting, illustrated and other matter relating to problems in connection with furnace control. Engineers in charge of large power stations can have these three numbers in a suitable binding case if they apply to the firm.

The Gilbert Arc Lamp Co., Ltd., Chingford, Essex.—Full catalogue of 48 pages, on the front cover of which appears an excellent and impressive illustration, in colour, of the Beacon lamp. The contents of the catalogue relate to the Gilbert arc lamps and accessories, a list of some of the 100 towns and public authorities and works using them leading off, followed by a number of photographic views of street, shop and other lighting by means of these flame and enclosed lamps. Descriptive matter relating to the lamps is given, together with instructions for trimming, and tabulated data as to hours of burning, size and weight of lamp, shape of globe, price, and code-word. Such information is published regarding the "Flamme," the "Beacon," the "Allight" series or series-parallel lamps, standard rod-feed, photo-printing, "Trudaylyte," carbon-feed, "Culinan," and open-type lamps. Among the accompanying manufactures that are particularised are the following: Resistances, lamp transformers, auto-transformers, constant-current transformers, automatic regulators, various switches, automatic cut-outs, post and lowering gear, winches, lamp carriers for street lighting, &c.

Messrs. Davies & Metcalfe, Ltd., Romiley, near Manchester.—40-page catalogue, in which are described, illustrated and priced, their various injectors, including automatic hot water and restarting injectors, Giffard and exhaust-steam injectors, water lifters, air ejectors, steam valves and other boiler fittings.

Messrs. Richardsons, Westgarth & Co., Ltd., Hartlepool.—Publication describing their "Cascade" cooling tower, and showing the principle employed very effectively by means of white on black cross-section and long section diagrams.

The Knapp Electric and Novelty Co., 511, West 51st Street, New York.—Catalogue No. 21, giving illustrated particulars and prices of a number of battery motor models in miniature, toy electric locomotives, &c.

Messrs. Wm. Wadsworth & Sons, Bolton.—Two attractively prepared pamphlets, each of 24 pages; one giving a full and interesting account of the "Wadsworth" electric lift for hotels, hospitals, offices, &c., the other dealing with the Wadsworth transporter for works, mills and warehouses, where material has to be handled economically and expeditiously. Both publications are fully illustrated.

Messrs. Siemens Bros. & Co., Ltd., Caxton House, London, S.W.—Supplement No. 1 to Catalogue No. 520, describing their instrument protector for protecting telephone instruments from high-tension or "sneak" currents; Catalogue No. 529 containing description of their electric motor syrens for signalling.

Messrs Elliott Bros., Century Works, Lewisham, London, S.E.—Leaflet (Section F) describing the firm's type N moving-coil instruments and giving prices, dimensions, &c.

Mr. G. Braulik, 8, Lambeth Hill, London, E.C.—Four-page pamphlet, No. 6, giving illustrated particulars and prices of a variety of pocket light sets, battery candle lights, and other novelties for the season, also spare batteries and "Eclipse" metal-filament battery lamps. Also pamphlet for the current season, showing a variety of white porcelain insulators for pole arms, chimney, wall or saddle brackets, &c., and giving revised prices of same.

Warner Engineering Co., Ltd., Carteret Street, Westminster, S.W.—Two illustrated catalogues issued by the company's two British licencees in the mining section, namely, the Wilfley Mining Machinery Co., Ltd., Salisbury House, London Wall, E.C., and Hartley, Causton & Richmond, Ltd., Spencer House, South Place, London, E.C., and Stoke-on-Trent. We are informed by the Warner Co. that a number of licences are being arranged in France and Germany, and that at an early date, 10 works will be manufacturing Warner non-parallel axle trucks under licence in each of these countries.

The Adams Watkin Co., Ltd., 36-38, Victoria Street, London, S.W.—New 20-page catalogue of the "Watkin" "turn-up-and-down-like-gas" switch. It contains notes on the advantages of the device, a report by Faraday House, and a good deal of interesting matter concerning the switch and its uses, followed by a number of well-known London stores and showrooms where the switches can be seen effectively demonstrated. A page of prices appears at the end. Arrangements are being made to manufacture a smaller switch, to be known as the "Baby" type, at a very low figure, giving three positions, namely, "full," "dim" and "off."

Messrs. Falk, Stadelmann & Co., Ltd., 83-87, Farringdon Road, London, E.C.—New catalogue (No. 309) of 20 pages giving full particulars of their "Efesca" metal-filament lamps, with tabulated prices of same for the 1910-11 season. Anyone in the trade who has not received a copy can secure one on application.

The Adnil Electric Co., Ltd., Adnil Building, Artillery Lane, London, E.C.—New catalogue (T 68) of 28 pages giving illustrations and descriptions, and in most cases prices, of motors, dynamos, switchgear, telephones, signalling apparatus and accessories for electrical installation work in collieries, mines, &c.

The Walsall Electrical Co., Ltd., Walsall.—Eight-page catalogue of direct and alternating-current meters for switchboards, testing and portable use, including deadbeat moving-coil type instruments, "moving" iron meter, the "A D" instrument, the handy railroad and "M" meters.

Messrs. Bullers, Ltd., 6, Lawrence Pountney Hill, Cannon Street, London, E.C.—Four-page fully illustrated list containing a description of their patent ventilators for underground cable boxes, pits, and transformer chambers. Sectional views of the roadway and pavement types appear. These ventilators are being used by many municipal authorities, including Birmingham, Oldham, Sheffield, Wolverhampton, &c., and they have also been used by the Postmaster-General. A small red-covered pamphlet of some 36 pages on cable-joint box explosions has been issued for the purpose of bringing these boxes before electricity supply engineers.

Mr. Ch. Rudolph, 66, Rue du Theatre, Paris.—(Mr. W. Craig, 11, Queen Victoria Street, London, E.C.).—Illustrated leaflet giving prices of flexible metallic tubing, steam gland connections, rubber connections for flexible tube, &c.

The British Westinghouse Electric and Manufacturing Co., Ltd., London and Manchester.—The new Electrical Supplies Catalogue, No. 201, is an abridged edition consisting of close upon 180 pages (roughly 8 in. × 4¾ in.). A four-page full alphabetical index leads off, and later we find arranged compactly and neatly an enormous variety of lighting, telephone, bell, heating, ventilating and other electrical manufactures. Carbon-filament and Auriga metal-filament lamps, "Arcturus" flame and enclosed arc lamps, carbons, mercury vapour lamps, ceiling roses, lampholders, tumbler, main, knife, weather-proof, and other switches, switch and distribution boards, fuses, wires and cables, insulators, electric light fittings and shades, Holophane reflectors, hand lamps, Trafford conduits and fittings, bells and pushes, telephones and telephone insulators, electric fans, radiators, ovens, hot plates and kettles. We name these to indicate the wide scope of the list. Prices are set out in detail.

LIGHTING and POWER NOTES.

Australia.—A company is being formed at Toora (V.), with 1,000 shares of £1 each, for the purpose of installing a plant to provide electric lighting and power for the town by utilising the power derivable from the Franklin River Falls and other sources in the neighbourhood. The chairman, Mr. James Allan, said that he and Mr. A. H. Wood, electrical engineer, of Melbourne, were willing to take up conjointly, one-half of the shares, or more if necessary. A 75-H.P. plant could be installed and completed for £1,000.

An Australian newspaper states that the Newcastle (N.S.W.) City Council has, during the past 12 months, been called upon to pay a large sum in damages owing to accidents occurring in connection with the municipal electric light wires, and there have been numerous complaints recently regarding the inefficiency of the electric light service generally. The City Council has now appointed a committee to institute a searching inquiry into the working of the service, and it has been agreed to engage an expert, at a fee of 25 guineas, to assist.

The secretary of the Numurkah (V.) Shire Council has been instructed to obtain an expert report on electric lighting.

The Footscray (V.) City Council has adopted a scheme for electric light and power. The Council will purchase and erect poles, wires, lamps and other fittings, at a cost of £8,000, and obtain the electricity in bulk from the Melbourne City Council's electric supply department, the cost being 10½d. per unit, £8 per KW. maximum demand. According to the *Australian Mining Standard*, the full scheme provides for 10 arc lamps of 2,300 C.P., 20 arc lamps of 1,500 C.P., 270 metallic-filament lamps of 100 C.P., and 100 metallic-filament lamps of 50 C.P., making a total of 400 lamps, aggregating 52,000 C.P., as against 15,000 C.P. obtained from the existing 280 gas lamps. It is estimated that within three years fully 10 per cent. of the establishments in the district will be lighted electrically, and that the more adequate illumination of the streets will contribute materially to the progress of the city. The cost to private consumers will be 5d. per unit for lighting and 2d. per unit for power. A committee has been empowered to take all necessary steps to install the light as speedily as possible.

Belfast.—The new scheme of electric lighting, from Castle Junction to the Albert Memorial, was put into operation on the night of the 15th inst., when Councillor Williamson switched on the installation, which consists of 16 2,000-C.P. lamps, arranged in fours.

Bradford.—At a meeting of the Bradford Chamber of Trade held on Monday, the hon. sec., Mr. F. Pickering, reported upon the visit of a deputation to the chairman of the Corporation Electricity Committee and the electrical engineer to discuss the question of the possibility of a reduction of the charge for electricity to the small users, which at present stands at 4d. per unit. Mr. Pickering said the representatives of the Corporation had convinced the deputation that there was hardly any prospect of a reduction because, as a matter of fact, if the cost of putting in the cables was taken into account, the Corporation were losing money at present on the small users. It was found, he said, that the average use of electricity in shops and offices did not amount to more than one hour per day all the year round, and that was the reason why the cost could not be reduced. Also by reason of the introduction of filament lamps, although the number of small users had considerably increased, the amount of electricity used by them had substantially decreased.

Bulawayo.—The Bulawayo Waterworks Co., who own the electric light works, showed a loss on the year's working of the electric light of £1,843, due entirely to the substitution of the metallic-filament lamp for the old type. "To add further to their troubles, it is proposed to introduce in next Parliament a Daylight Saving Bill, under which all the clocks in the country will be put back one hour, so that town lamps, bars, hotels, &c., will shut down one hour earlier than at present."

Cape Colony.—Cradock.—According to a report in the Press, the secretary of the General Electric Co., London, and the Government electrical engineer have recently been in this town negotiating with the Council regarding the town electrical installation.

Uitenhage.—The Uitenhage electric light scheme, which was undertaken by the General Electric Co., of London, was completed on August 26th. The Deputy-Mayor, Mr. Whiteside, chairman of the Lighting Committee, switched on the light for the first time, in the presence of a large gathering. The event was celebrated by a banquet, under the auspices of the Town Council.

Chadderton.—The U.D.C. has had under consideration an application from the Oldham Corporation for the consent of the Council, under Sec. 55 of the Oldham Corporation Act, 1909, to the supply of electricity to intending consumers within the urban district of Chadderton. It was suggested by the clerk that consent be given provided the Corporation gave an undertaking that, if at any future time the Council wished to supply electricity itself, the Corporation would sell to it on demand the whole of the mains laid in the district. A member moved that this course be adopted. Another thought that the matter should remain open pending the receipt of replies to a circular as to the number of firms likely to require electrical energy. It was decided to adjourn consideration of the matter for a month.

Canada.—Our correspondent, writing from Ottawa, under date September 7th, says:—"A charter of incorporation has been issued to the Canadian Power and Paper Co., with a capital of $10,000,000. The mere announcement conveys nothing until the statement is made that the incorporators are the same gentlemen who have made their mark by being responsible for so many of the MacKenzie and Mann companies. The powers granted are of the most extensive character, and practically give the new company monopolistic powers over their enterprises, except where the interests of municipalities are safeguarded, as they have been both by the Secretary of State and the Minister of Railways, by the provision that any such contracts must be subject to confirmation by the municipalities concerned therein.

"Following a decision by the Board of Control, public tenders are being invited for the lighting of the city of Montreal for the ensuing 10 years. In order that no company will have a monopoly, tenderers may light certain parts of the city and not necessarily the whole of it. By this arrangement it is expected that a number of offers will be received. All parts of the city are to be lighted. The number of arc lamps used for public lighting purposes in all parts of the city, with the exception of about half a dozen suburbah districts, which are under contracts with a certain company for lighting, are approximately 1,650 lamps, and the number of incandescent lamps of various candle-powers, approximately 500 lamps. What are known as the Standard arc and incandescent lamps must be supplied. The lamps shall be 40 and 80 candle-power respectively.

"The Pend d'Oreille River, near Nelson, B.C., is to be electrified. Permission has been granted to a company who will develop 25,000 H.P. There is expected to be a ready sale for the power in the Pend d'Oreille valley and at Nelson, and what may not be used locally can be marketed across the international boundary. It is expected that this power will greatly stimulate industrial and mining development.

"The Canadian General Electric Co. is now building three immense generators for the Ontario Power Co., Niagara Falls. These machines are each 12,500 H.P. The casting was done in Toronto by the Canada Foundry Co., and was moulded and cast in one piece. The casting has a mean outside diameter of 23 ft., and is 4 ft. wide."

Colchester.—At a recent T.C. meeting the Electricity Committee unanimously recommended the Council to authorise the electrical engineer to suspend or dismiss any member of the staff if he deemed it necessary, the circumstances to be fully reported to the ensuing meeting of the Council. The report was adopted.

Continental Note.—HOLLAND.—It is reported that the municipal authorities of Deventer and Zwolle are considering a scheme for the establishment of a joint central station for the electric lighting of their respective towns

Dundee.—At the City Valuation Court appeals were intimated on behalf of the Electricity Department, one for a reduction of a £6,000 valuation to £4,546, and the other from £12,000 to £8,187. The Assessor complained that difficulties had been put in his way as to the valuation of municipal undertakings. The hearing of the appeals was adjourned.

Mr. Harry Richardson, Corporation electrical engineer, referring at a meeting of the Electricity Committee to an attack made on municipal officials by the Assessor in connection with the valuation of Corporation undertakings, said the officials were charged with, if he remembered rightly, dishonourable conduct, and if the charge had been made personally against him, he would have taken it further. Mr. Richardson stated emphatically that as far back as January last he provided the Assessor with all the information he desired, and, in fact, that information was taken as the basis of the valuation.

In the Greenmarket electric lighting is taking the place of the old-fashioned naphtha lamps. A standard has been erected, and by means of overhead wires the current will be conveyed to the stalls.

Dunfermline.—The B. of T. has taken exception to part of the Corporation's Electric Lighting Order. The part that the Board considers impracticable was a suggestion from the Fife Electric Light and Power Co. It was not a proposal of the Council, and it is said, therefore, that the company must make a more reasonable proposal, which must be agreed to by both parties. The proposal was that in 30 years the Council would take over consumers up to a certain limit, the company retaining the larger consumers. The Board of Trade objected to this dividing of the undertaking.

Durham County.—The electrical installation at the West Stanley Colliery having recently been increased, an important extension of mains is about to be made by the Cleveland and Durham Electric Power, Ltd., for the purpose of giving a duplicate supply. These mains will carry current at a voltage of 11,000, and will be supplied from the Pelton sub-station, where current is transformed down from 20,000 volts to 11,000 volts. The cable is an overhead pole line, the distance between the poles being 80 yards, and the line consists of 3·05 sq. in. copper conductors. Where the line crosses roads and railways catenary guard wires are hung, while over footpaths lace guards are used. In addition to the main cables for carrying current, pilot cables and telephone cables will also be carried by the pole lines. Both of these cables are protected against breakdown of supply by the Merz-Price balanced protective gear, which has the effect of automatically isolating any portion of the cable in which a fault from whatever cause occurs.

Enfield.—The U.D.C. has consented to a trunk main being laid by the North Metropolitan Electrical Power Supply Co. from Enfield, to Wood Green, *viâ* Burleigh Road, Lincoln Road and London Road.

Epsom.—The U.D.C. have decided not to re-appoint Mr. Herbert F. Foster as consulting engineer to their electrical undertaking. Mr. Foster wrote a letter asking for reappointment, but the decision was as stated.

Edinburgh.—Regarding the cooling towers at Dewar Place power station, Sir Alex. Kennedy has reported to the E.L. Committee that he had associated himself in drawing out the scheme with a gentleman who had experience in engineering architecture. The Committee could, therefore, have his assurance that the new cooling towers would be in no way detrimental to the amenity of the district. The scheme will cost £45,000. Reporting on the disposal of the surplus for the past year, Sir Alex. strongly advised that, in view of the resolution to scrap the old machinery in Dewar Place and substitute newer and more economic machinery, the surplus should be applied towards the payment of the outstanding proportion of the original cost of the old machinery. The cost was £21,000, of which half had been paid up. The Committee adopted the recommendation. Regarding the proposed extension of the supply mains to the Barnton district, Sir Alex. Kennedy reported that he had had an interview with the officials of the B. of T., who stated that no previous application had yet been considered under the new Act, but they seemed to think that the Board would not give the T.C. indiscriminate power to supply any consumer outside the town area.

Heckmondwike.—The L.G.B. has intimated to the D.C. that a local inquiry will be held with reference to the application for further borrowing powers on account of the electricity works, as soon as the engagements of the Board's inspectors will permit.

India.—LAHORE.—The *Civil and Military Gazette*, an Indian paper, says:—"We cannot congratulate the Lahore Municipality on its decision in regard to the scheme for electric lighting. The Municipal Committee had wisely consulted one of the first experts in the world, and that gentleman produced a scheme which a Committee of the Municipality recommended for adoption. The scheme was an eminently practical one, providing an assured income almost from the initiation of the work, and for the gradual extension of the electric service throughout the municipal area as the demand for it arose. But in the eyes of some members of the municipality it had the defect of providing for the wants of the area outside the city before the city itself. It is, of course, a matter of no consequence to these patriotic citizens that the result of their action has been to destroy all chance of any municipal scheme being carried through, for it is absurd to suppose that a Committee without a single expert among them can produce a more practicable scheme than that which has been rejected. There is no possibility of estimating what the demands of the city for electricity will be, but it is certain that some years must elapse before the bulk of the city population will be prepared to pay for electric light, fans, &c. And it should be evident even to the Municipal Commissioners that street lighting without any private demand for power is financially impracticable. But the absurd jealousy which cannot permit one part of the municipality to benefit unless the whole area receives the same advantages simultaneously has wrecked a promising scheme, and in all probability put off the adoption of a modern system of lighting for many years."

The *Times of India* states that the Government of India has now drawn up the revised rules for working the Electricity Act, and it is understood important changes have been made to meet the objections which were raised in Council during the final stage of the Bill.

Kilkenny.—The district lunatic asylum has just been lighted by electricity. The power house from which the supply is derived is situated in close proximity to the main building, and contains two Hornsby gas engines (37 H.P.) and dynamos. The storage battery will serve to light the asylum at night. The dining hall, the day rooms and divisions are all fitted with electric light, the entire C.P. in the former being 8,550. The total number of lamps is about 700, varying from 8 to 65 C.P.

Launceston.—At a meeting of the T.C. on Monday the town clerk submitted a draft agreement with regard to electric light. This was generally approved, but it was decided to communicate with some other towns where a similar agreement had been entered into before confirming the matter.

Listowel.—The T.C. has an electric lighting project on foot, and the clerk is in communication with several electrical firms on the subject.

Llanelly.—The laying of mains has been commenced by Callender's Cable Co., and it is anticipated that the town will be lit by electricity, together with the Athenæum Hall and Town Hall, for the new year.

London.—BERMONDSEY.—A special meeting of the Council will be held on October 18th to consider the question of applying to the Board of Trade for a provisional order enabling the Council to supply electrical energy in the district of the late St. Olave Board of Works. The Electricity Committee, in a report upon the matter, reminds members that the Council has twice applied for, and been refused, such extension by the Board of Trade. There

is no doubt the reason the Board refused the application was the fact that there were already two companies supplying the area. The Committee is unanimously in favour of the application being made. Agreements have been entered into with the following firms for the supply of energy for power:—London Chrome Tannery, Ltd., 83, Bermondsey Street; F. Claydon and Co., 20-4, Fulford Street; Pipers, Ltd., 54, Bermondsey Street.

St. Pancras.—The borough treasurer reports having obtained from the chief electrical engineer particulars of the estimated requirements for the year ended March 31st, 1911, as follows:—Mains, £2,000; services and switches, £1,700; meters and indicators, £800.

Hammersmith.—On July 27th last the Council conditionally approved a proposal to permit the new Olympia Co. to generate current at Olympia for the purpose of the electrical exhibition in September, 1911, the company to pay a royalty of ¾d. per unit generated. The company now desire the Council to fix a lump sum, if possible, to be charged as royalty in lieu of the suggested charge. The Electricity Committee having considered this application has decided that an alternative charge be offered at the rate of £1 per KW. installed during the period of the proposed exhibition.

Stoke Newington.—An additional transformer is to be provided at Edwards Lane sub-station, for use in the event of a breakdown, at an estimated cost of £100. The Electricity Committee has for some time past been in negotiation with the North Metropolitan Electric Power Supply Co., on the subject of a revision of the present charges to private house lighting consumers, with the result that the company has expressed its willingness to agree to the following, viz.: That the present rate of 7d. and 2d. on the maximum demand system shall be continued and apply to the whole borough, with the proviso that, if during the six months ending March 31st next, or any subsequent year ending March 31st, the average charge to the consumer shall exceed 5d. per unit, he shall be entitled to a credit (off the March quarter's account) of the amount by which his total charge for the whole period has exceeded an average of 5d. per unit. Under this system an opportunity will be given to all consumers in private houses of benefiting by careful use of the current, whilst at the same time they will be safeguarded from a charge exceeding an average of 5d. per unit. The Committee has provisionally approved the above.

Deptford.—The Public Libraries Committee recommend electric lighting for the New Cross Branch Library, this being regarded as the most suitable system for library buildings, and advantageous terms having been arranged with the London Electric Supply Corporation, Ltd.

Lymington.—The T.C. has sealed a contract for public lighting with the electric lighting company.

Macclesfield.—The New Electricity Co., of Macclesfield, Ltd., have applied to the T.C. for consent to their application for a prov. order for E.L. Before coming to a definite decision, the Council has decided to ascertain whether the Railless Electric Traction Co., Ltd., intend proceeding with their application for a similar order.

Manchester.—The secretary of the local Ratepayers' Association having written to the L.G.B. objecting to the granting of a loan for electricity purposes without a public inquiry, and asking on what legal authority the inquiry had been dispensed with, the Board has now written under date September 13th, giving particulars of the purposes for which the money was required, and stating "that the question of holding a local inquiry was a matter entirely within the Board's discretion." The letter proceeds to state that the Board has received a further application from the Corporation for sanction to a loan of £30,000 for the provision of a turbo-alternator at the Stuart Street station, and has decided, in this instance, to hold a local inquiry.

Morecambe.—With reference to the blowing down of the new cooling tower of the Corporation electricity works, we are asked to state that the designs upon which this tower was constructed were neither prepared nor approved by Mr. W. R. Wright, the consulting engineer, who has terminated his agreement with the Morecambe Council.

Morley.—After conference between the Electricity Committee and the Co-operative Society's directors, it appears that the latter intend to provide their own plant for lighting the Central Stores. The Committee, however, informed the society that if the directors would first install Osram lamps throughout their premises the saving would be so great that they would find it unnecessary to provide separate plant.

Newcastle-on-Tyne.—Owing to the increasing demand for electric power at Messrs. Hawthorn, Leslie's engineering works at Walker, some important additions have recently been made to the electrical plant in the sub-station of the Newcastle-upon-Tyne Electric Supply Co. at Walker, from which these works are supplied. The sub-station buildings have been extended, and consist of three transformer chambers, 29 ft. × 21 ft. × 14 ft. high. This sub-station is built inside a larger building, and is used for reducing the pressure from 5,500 volts at which it is received from the generating station to a pressure of 440 volts, at which it is used in the works. The total capacity of the sub-station is now 2,000 H.P., there being three 700-H.P. transformers, oil-cooled. The high-tension switchgear is the same as before, being of the Brown, Boveri "Grid" type, supplied by Messrs. Richardsons, Westgarth. It consists of two feeder panels, each of 2,500 KW. rated capacity at 5,500 volts, and three transformer panels, each of 1,000 KW. rated capacity, while one extension panel is allowed for. The low-tension switchgear is of the Reyrolle ironclad type, with three transformer panels, each of 1,000 KW. at a voltage of 440. There is also a small 30-volt battery, used for the tripping switches on the protective gear. The new installation was set at work on August 17th.

Oldham.—Mr. Newbigging, electrical engineer to the Corporation, foreshadows that an extension to the electricity station plant will be necessary by the winter of 1911-12, and that the work will have to be undertaken next summer.

Oswaldtwistle.—Before entering into an agreement for obtaining a supply of electricity or deciding to install a generating station, the D.C. is ascertaining the probable demand.

Partick.—The surplus on the electricity undertaking for the past year amounted to £1,372.

Portsmouth.—A L.G.B. inquiry was held on Saturday into the application of the T.C. for a loan of £24,000 for E.L. purposes for the next three years. On a previous loan of £22,288 there was an outstanding balance of £1,914.

Rotherham.—Agreements have been executed for the supply of electricity to Tinsley by the Sheffield and Rotherham Corporations, the former to Messrs. W. Cooke & Co., Ltd., and Messrs. Edgar Allen & Co., Ltd., and the latter to the British Abrasive Wheel Co., Ltd., and the Sheffield Simplex Motor Works, Ltd.

Southampton.—Messrs. Cash, Stone & Co., the professional auditors, in their annual report on the accounts of the Council, state that the sums standing to the credit of the depreciation and renewals fund of the tramway department and the electric light department on March 31st last were £20,263 (an increase of £5,190 on the previous year), and £9,815 (an increase of £1,925 on the previous year) respectively. £2,000 has been appropriated in relief of the rates from the tramway department and £2,424 from the electricity department, and the auditors presume that, before making these appropriations, the Council was satisfied that the sums standing to the credit of the depreciation and renewal funds were sufficient. The Southampton Gas Light and Coke Co. wrote to the Council declining to disconnect any further gas lamps until the company had been paid for the disconnections to date. The accounts, amounting to £155, are to be paid, and the gas company is to be requested that the disconnections required by the borough electrical engineer be proceeded with.

Swinton.—The Manchester B. of G. has decided to have electric power installed in the bootmaking department at the Swinton Industrial Schools. Current will be supplied by overhead mains by the U.D.C. acting with the Lancs. Electric Power Co.

Truro.—Provided that the terms of the order are approved, the T.C. has decided to offer no objection to the application of Messrs. J. & W. Purves for a prov. order for electric light.

Twickenham.—The Lighting Committee of the Council has under consideration letters from the Twickenham and Teddington Electric Supply Co., Ltd., with reference to the terms upon which they would be prepared to contract for the lighting of the whole or a portion of the street lamps in the district.

Tynemouth.—The borough accountant (Mr. Thomas Kershaw), in his abstract of accounts for the past year, says that the working of the electrical department was very satisfactory. The income amounted to £16,924, and the expenditure to £9,882; leaving a balance available for transfer to the net revenue account of £7,042, representing 41·6 per cent. of the gross income. The sum required for interest and redemption was £6,273, so that there was a net profit of £768, which reduced the accumulated revenue deficit to £3,862. The capital expenditure up to March 31st, 1910, was £93,439, and after allowing for sinking fund available, the net debt was £73,794.

Walthamstow.—The Electricity Committee has decided that a 1,000-KW. mixed-pressure turbine with tandem generators of 500 KW. each, and including condensing plant, pipework, cooling tower, switchgear and the necessary foundations, be installed at the station at an estimated cost of £9,500. The car-shed is to be extended, and the alterations required to the overhead equipment are to be carried out by the tramways engineer.

Wells.—The Wells Gas Co. is prepared to consider the question of electricity supply if there is a sufficient demand. Mr. J. A. Purves, of Exeter, is applying for a prov. order, and he is willing to interview the Lighting Committee.

West Ham.—Electric light is to be installed by the Education Committee in Salway Place School during the Christmas vacation.

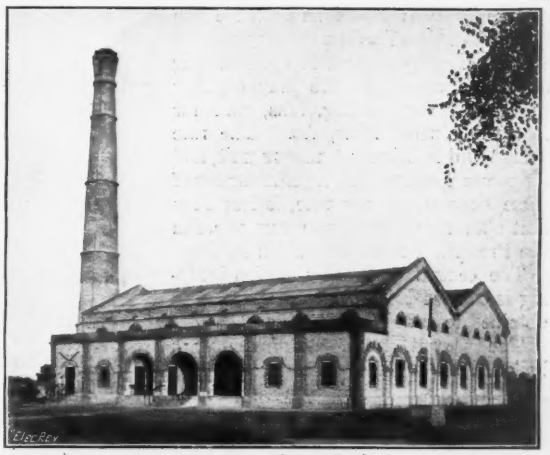
Yarmouth (I.W.).—The Town Trust has accepted the tender of the Yarmouth Electricity Supply Co. for public lighting.

Yeovil.—The T.C. has decided to take no action for the present respecting the application of Messrs. J. & W. Purves for a prov. order for E.L.

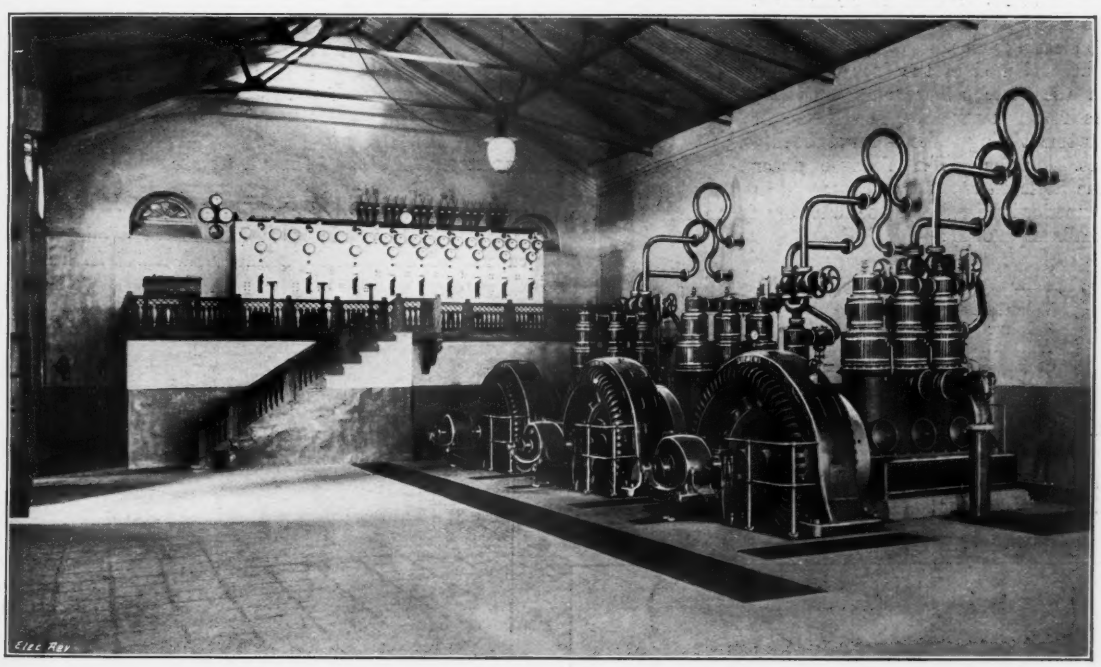
THE ELECTRICAL INSTALLATION AT BIKANER, INDIA.

We have lately devoted a great deal of space to electrical affairs in India, this being one of our best markets, and one in which there appear to be very great opportunities for further development. We are now able, by courtesy of Messrs. Siemens Bros. Dynamo Works, Ltd., to place before our readers some photographic views of an interesting installation which has been making progress in one of the Indian States for several years. For the accompanying descriptive notes we are indebted to a Bombay and Calcutta contemporary—*Indian Industry and Power*. The writer of the article in this journal first points out that it is only in the last few years that the various Indian States have proceeded with the installation of electric supply within their territories.

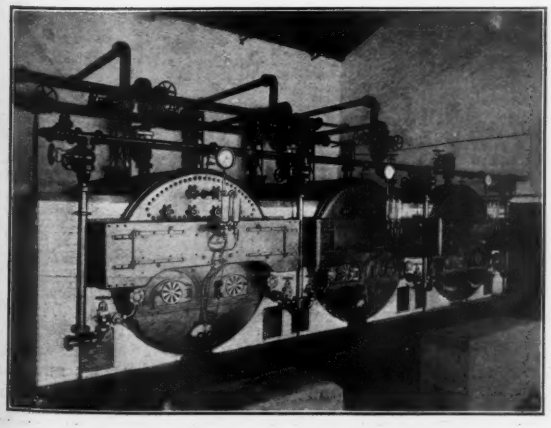
It may be a surprise to some to know that it was as long as 24 years ago that the first electrical equipment in Bikaner was put down. It was but a small affair, of course, and was designed purely for lighting purposes within a palace in the Fort. In 1899 a somewhat larger equipment consisting of two 30-H.P. sets was installed for supplying power to the new Lalgarh Palace, but it was left to the present Maharajah to decide upon the provision of an equipment worthy of the chief city of one of the most progressive States in India. Col. His Highness the Maharajah of Bikaner rules with a progressive spirit over a territory of 23,311 square miles, in which, at the census of 1901, there was a population of nearly 600,000. Bikaner city, which is his seat, the chief town and capital of the territory, possesses, we gather, one of the finest and most modern electrical plants in the East. In 1904 it was resolved to erect a comparatively large central generating station near the city for the purpose of carrying out a complete scheme which involved the transmission of electricity at high tension to sub-stations, situated at various points throughout the neighbourhood, for supplying power for lighting, fans and motors in the various public and private residences and offices, wells, workshops and for road and park lighting, &c. This central station was opened by Her Excellency Lady Minto in November, 1906, though at that time the work was far from complete, as only the Lalgarh Palace, the Club, and the gardens and roads in the vicinity



Bikaner Power Station.



Interior of Engine Room; Willans-Siemens Generating Sets.



Interior of Boiler House.

of these buildings, were equipped and ready to take power from the new station. Since then, however, great progress has been made, and in addition to lighting the various public buildings and offices and many private residences, and the provision of power for a number of workshops, wells, &c., nearly all the streets and roads both inside and outside the city and in the suburbs are now provided with electric light. A considerable number of private consumers are taking power in the city for lighting, fans, and for motors for small mills, &c. The rate charged for lighting is 4 annas a unit, and for power 2 annas a unit. The former of these charges, at any rate, is less than that obtaining for private consumers in the Presidency towns in British India.

The central generating station building is constructed of bricks and locally obtained red sandstone.

The present equipment of the main boiler house includes three Davey, Paxman Economic boilers with ring steam and water mains, a Worthington 6 × $4\frac{1}{2}$ × 6 vertical feed pump and two 75 sq. ft. vertical feed heaters, the latter obtaining their heat from the feed-pump exhaust.

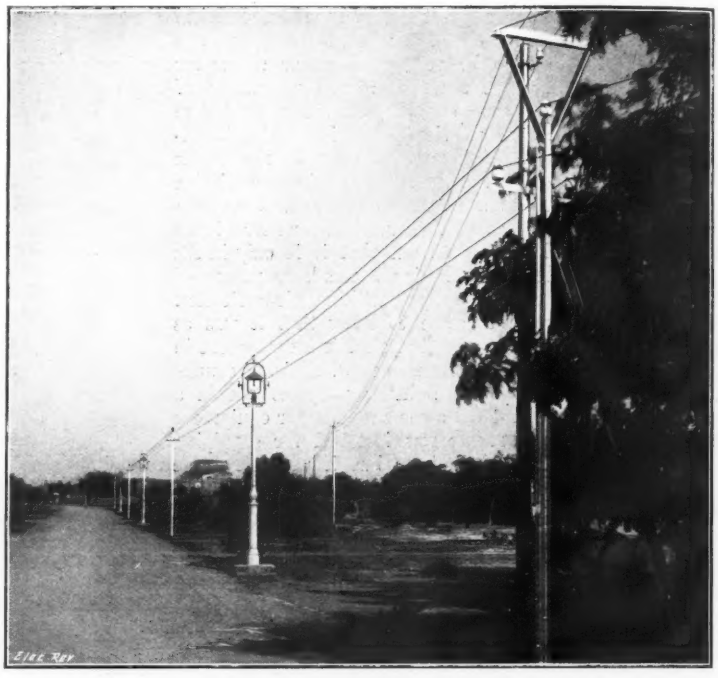
Provision has been made for extensions up to 1,400 B.H.P. and for the addition of condensing plant.

The coal used in the furnaces comes from the State colliery at Palana, 14 miles from Bikaner City, the Electrical Department being debited for it at the rate of Rs. 4/8 a ton. The mining engineer of the State characterises Palana coal as "a superior lignite," and the following is an analysis of a typical sample of it :—

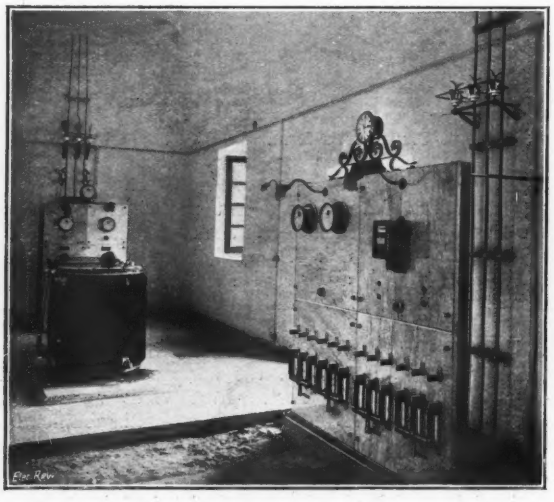
Specific gravity	1·21
Fixed carbon	39·28
Volatile matter	42·72
Sulphur	·20
Ash	9·60
Moisture	8·20
	100·00

Calorific value, 6,390 calories. Evaporative capacity, 11·26 lb. of water per lb. of coal consumed.

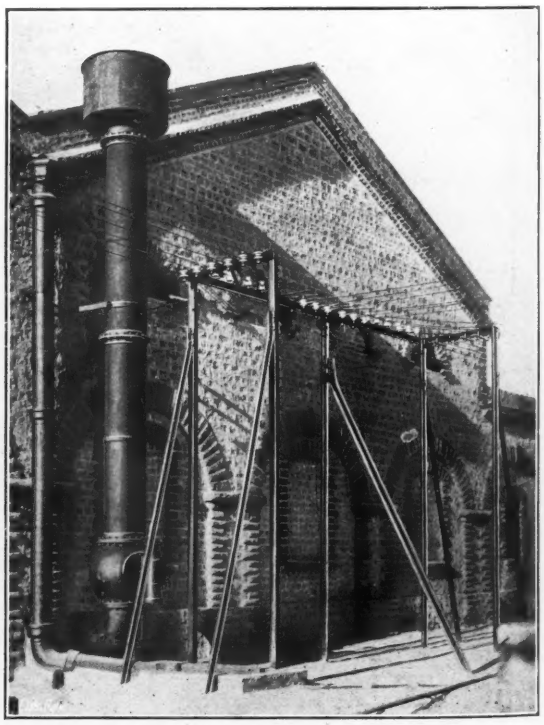
The engine house contains three main generating sets, each consisting of a Willans & Robinson central-valve three-crank compound engine, direct coupled to a Siemens three-phase sole-plate type alternator, having an output of 167 K.V.A. at 2,000-2,250 volts, 50 cycles, 375 R.P.M. The main switchboard consists of three generator control panels and six feeder panels. A sub-station is provided in the central station, equipped with two 50-K.V.A. 2,000/200-210-volt, 50-cycle, oil-cooled transformers, for supplying power at low pressure to two 20-H.P. and other smaller motors employed in the State workshops, to a vertical motor pump set at the Rattensagar Well, which has a capacity of 36 gallons a minute against 280 ft. head (water used mainly for the central station), and for fans and arc lighting in the neighbouring offices, bungalows and roads. The out-going mains from the central station are all of the overhead type, three-phase high-tension aerial



Transmission Line and Public Lighting.



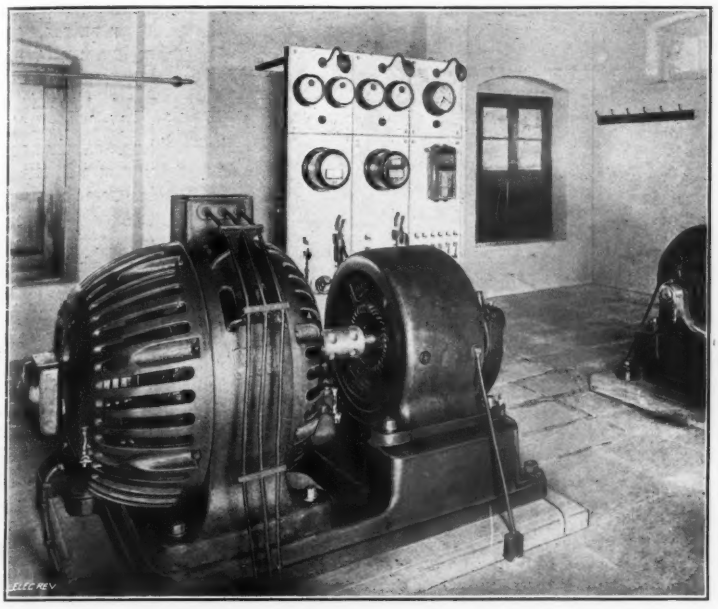
Interior of Transformer Sub-Station.



Derrick for Outgoing Feeders.

feeders being carried to the various sub-stations of which descriptions follow. A view of the overhead mains and of the road lighting is given in one of the illustrations opposite.

The Lalgarh Palace sub-station is equipped with two



Interior of Siemens Motor-Generator Sub-Station.

motor-generator sets, each consisting of an 86-H.P. three-phase 2,000-volt induction motor, direct coupled to a direct-current generator having an output of 250 amperes at 205-230 volts. An additional set with an output of 20 KW. is now being added. The sub-station supplies power for lighting and fans and for small motors at the Lalgarh Palace, the Makhma Khas Secretariat and the surrounding buildings; also to two vertical motor-driven Worthington-Siemens five-stage turbine pump sets at the Karnisagar Well, each having a capacity of 170 gallons per minute at 1,540 R.P.M., against a total head of 354 ft. It is of interest to note that this Karnisagar Well and the Chotina Well, which is mentioned further on, are the two deepest wells in India. The Lalgarh Palace sub-station also supplies power for the incandescent and arc lighting of the roads in the immediate vicinity of the buildings mentioned above.

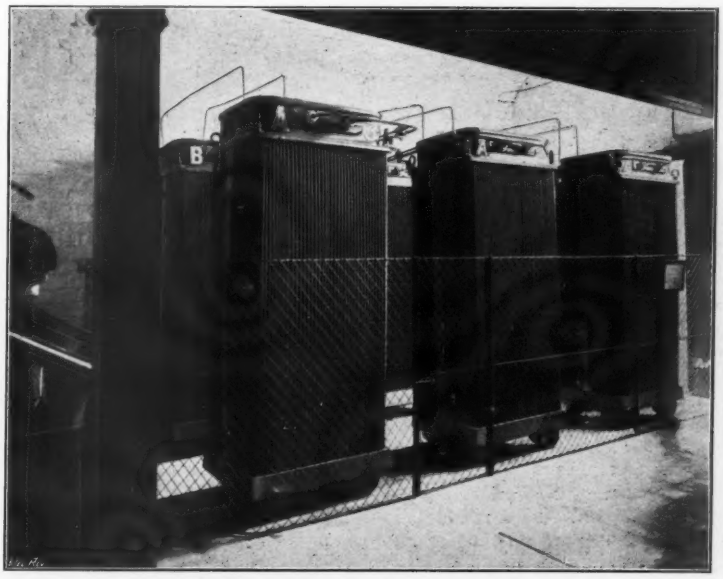
The Victoria Memorial Club sub-station is equipped with two motor-generator sets, each consisting of a 25-H.P. three-phase, 2,000-volt induction-motor, direct-coupled to a direct-current generator, having an output of 75 amperes at 205-230 volts. It supplies the necessary power for lighting and fans at the Club, the Prince of Wales's Hall, the Gymkhana, the Rink and the Polo Stands; also for the incandescent and arc lighting of the grounds around these buildings. A view of the plant in this sub-station is given above.

The equipment of the city sub-station at present consists of two 80-K.V.A., 2,000/200-210-volt, 50-cycle, oil-cooled transformers, and supplies power for lighting and fans and for motors in the various public buildings—the hospital, jail, &c.—and private residences and small factories in the city, also for road lighting inside the city and for the operation of the jail well by an ordinary rod pump driven by a 23-H.P. induction motor at the surface.

The Fort sub-station is at present equipped with two 40-K.V.A., 2,000/200-volt, 50-cycle, oil-cooled transformers, supplying power for lighting and fans and pump and lift motors in the fort. The installation in the fort is a very extensive one, as this fort is almost a small city in itself, with many beautiful palaces.

The Chotina sub-station is situated under the high-level tank, which supplies water to the parks and gardens, &c., outside the city. It is equipped with two 120-K.V.A. 2,000/200-volt, 50-cycle, oil-cooled transformers and supplies power to two 23-H.P. motors operating the new ice factory machinery, &c.; to two horizontal motor-driven seven-stage Worthington-Siemens turbine pumps in the Chotina Well, each having a capacity of 235 gallons a minute at 1,460 R.P.M., against a total head of 360 ft., and to a motor blower.

The successful installation of this system is stated to reflect great credit on Messrs. Siemens Bros. Dynamo Works, Ltd., who were entrusted by the State with the order for the whole of the plant. The work was carried out in accordance with the plans and specifications drawn up by Mr. G. R. Drummond, M.I.E.E., &c., electrical and mechanical engineer to Bikaner State (whose recent deed of heroism in the rescuing of natives from a deep well, recorded in our "Personal Column," will be remembered by our readers), and it was under his supervision also that the station and machinery connected with the scheme were erected and are now being operated. In this connection, it may also be mentioned that local labour only was employed in the erection, and is now employed in the operation, of the plant.

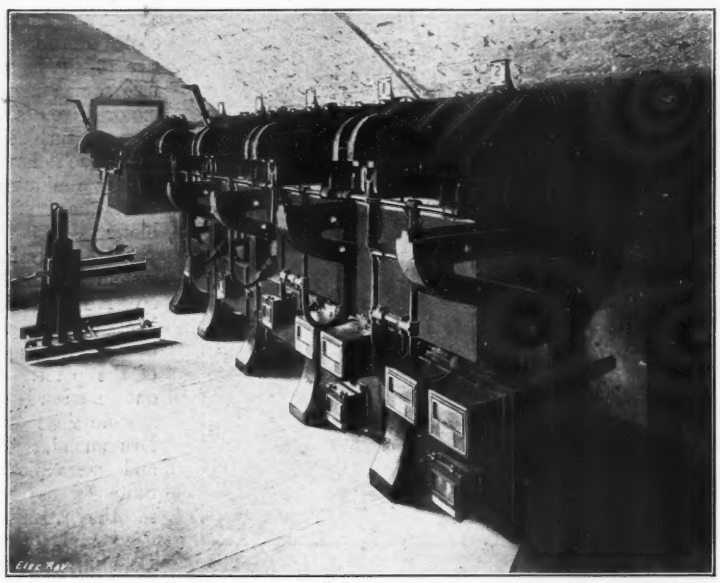


Westinghouse 10,000-Volt Transformers in the South Metropolitan E. L. & P. Co.'s Sub-Station, Catford (see p. 502).

Imperial Exhibition, 1915.—Sir Pieter Bam is actively engaged in interesting eminent authorities in a proposed Imperial Exhibition, to be held in London in 1915—the expected year of the next Colonial Conference, the 700th anniversary of Magna Charta, and the year in which the Prince of Wales reaches his 21st birthday. One of the principal objects of the exhibition will be to make an imposing display of what the Mother Country and the various Oversea States can produce and manufacture.

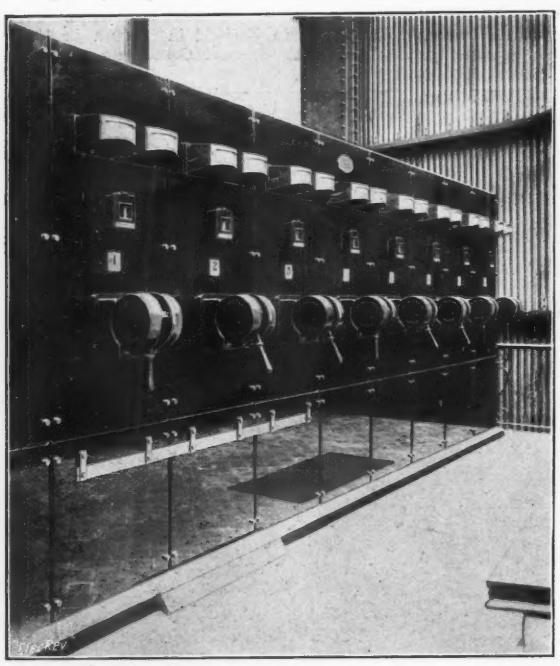
SOUTH METROPOLITAN ELECTRIC LIGHT AND POWER CO.'S TRANSMISSION SYSTEM.

Last week we paid a visit of inspection to the South Metropolitan Electric Light & Power Co.'s new extra-high-pressure transmission installation at Catford, which has recently been brought into use. Its principal feature of interest is the adoption, for the first time in this country on a large scale, of the Scott system of transformation from two to three-phase and *vice-versâ*. Before describing the installation, a brief explanation of the circumstances which have led to this step may be of interest.



Reyrolle 10,000-volt Switchgear in Catford Sub-Station.

The area served by the company is one of very great extent, comprising the whole of the region between the Thames at Greenwich and the northern boundaries of Croydon, Beckenham and Bromley, and measuring, roughly, 11 miles by 3½ miles. The generating station is situated at the extreme northern limit of the area, where supplies of coal and water can be obtained at the cheapest rate, and where it has consequently been found most economical to do the bulk of the generating.

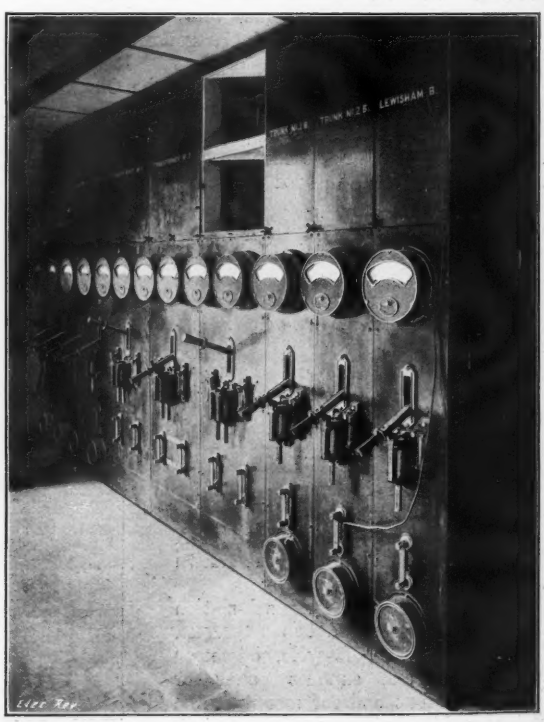


Switchboard at Generating Station.

In view of the rapid growth of the demand for both lighting and power, some four years ago Mr. H. W. Bowden, managing director and engineer-in-chief to the company, drew up a comprehensive scheme for the future development of the system, and commenced the erection of a new generating station adjoining the original power house, to contain eventually plant aggregating 32,000 kw.

In our issue of August 2nd, 1907, we gave a full description of the new station, in which two two-phase turbo-generators were installed, each of 1,500 kw. capacity, at 3,000 volts, 50 cycles per second. To these will be added, as required, generating sets of much larger size. At the same time it was decided to distribute at the stated pressure in the first instance, but to transmit power to sub-stations on the three-phase system at 10,000 volts when the load justified that procedure.

That time has now arrived, for the demand has attained a magnitude which would render the maintenance of uniform pressure over the whole network very difficult and uneconomical at the original pressure of 3,000 volts. Three-phase three-core lead-covered cables have therefore been laid from the generating station to Catford, in duplicate, each being capable of transmitting 1,500 kw.; spare ducts were available for the greater part of the distance, but for the rest trenching was necessary. The cables are of the British Insulated and Helsby Co.'s make, of 0·1 sq. in. sectional area,



Ferranti Switchboard at Catford Sub-Station.

with a copper earth shield under the lead sheathing, and are insulated for working with the centre point not earthed. From Blackheath to Catford they have been laid on the solid system.

The total length of the duplicate 10,000-volt transmission

line is 6½ miles, and the whole of the apparatus, including the cables, was tested with a pressure of 20,000 volts before being put to work.

The step-up transformers, which were supplied by the British Westinghouse Electric and Manufacturing Co., Ltd., are of the oil-cooled type, and are arranged in three 500-K.V.A. sets, each set consisting of two single-phase transformers connected on the Scott system, the primaries being coupled to the two-phase bus-bars at 3,000 volts, and the secondaries giving three-phase current at 10,000 volts. The step-down transformers at the Catford sub-station are of identical design, and are illustrated on p. 501 ; they stand over 7 ft. high, and weigh some 3 tons each ; they are mounted on trucks so that they can easily be moved, if necessary.

At the power station the switchboard consists of three 3,000-volt two-phase panels, for the transformer primaries, and five 10,000-volt three-phase panels, of which three serve the transformer secondaries and two the outgoing feeders. We give an illustration of the front of the switchboard, which is of slate. The low-pressure panels are provided with an ammeter in each phase, and with overload trip release attachments with time limit device. The switches are inserted only in circuit with the "inner" of each phase, the outers being joined to an earthed bus-bar through copper links. Each of the 10,000-volt panels is equipped with ammeters on two of the phases, and overload release attachment with time limit, worked through series transformers.

The whole of the switchgear at the power station is of Messrs. Reyrolle's ironclad type, but in this instance it is, as stated, operated from a switchboard of ordinary appearance, with the aid of flexible wire cords and levers, as shown.

At the Catford sub-station, the 10,000-volt switchgear is mounted on a gallery, and comprises two incoming feeder panels and three transformer panels. Here, again, the Reyrolle switchgear is used, in this case in the usual manner ; it is shown in the accompanying illustration, with the furthest switch racked out, and in front of it the carriage with which the oil tank or the whole of the oil-switch can be removed. The transformer panels are provided with overload release on two of the phases, as at the power house, but no ammeters : the feeder panels are equipped with reverse-current relays of the British Thomson-Houston Co.'s make, operated by potential transformers arranged in the Reyrolle switch oil-tanks (which, it will be seen, are made deeper than usual for the purpose). The relays, overload trip solenoids, &c., are mounted on hinged panels, so that the connections can readily be inspected, and the series transformers, with the bus-bars, &c., are filled in solid with insulating compound, the whole of the high-pressure switchgear being as safe to operate as it is possible to make it. The transformers are switched on as the load rises, one set sufficing during light loads.

The 3,000-volt switchboard at the sub-station is of Messrs. Ferranti's ironclad type, and comprises three two-phase transformer panels, and seven single-phase feeder panels. The switches are all of the oil-break type, and are protected by overload releases and time-limit attachment. The "outers" of the cables are connected to an earthed bus-bar with copper links. We give an illustration of the board, with one of the bus-bar compartments open, showing the disconnecting links.

For some time the 10,000-volt cables were employed to relieve the 3,000-volt feeders, pending the completion of the plant ; this has now been accomplished, and the change-over has been made, with satisfactory results. The plant to be installed at the generating station in the future will all be of the three-phase type, generating at 10,000 volts, this being advisable in view of the probable adoption of a scheme for linking up the large London stations at some future date ; and the transmission line now laid down will, of course, work in with such a scheme.

Our thanks are due to Mr. H. W. Bowden for the opportunity of preparing this article, and to Mr. W. J. Allbright, resident engineer in charge of the distribution department, for the particulars which we have embodied in it, and for his kind assistance in its preparation.

THE MUNICIPAL TRAMWAYS CONFERENCE.

The annual Conference of the Municipal Tramways Association—the ninth meeting of the series—which this year is being held in Bradford, under the presidency of Mr. C. J. Spencer, the general manager of the city tramways, was opened on Wednesday morning in the Town Hall.

Not alone from the fact of its well-known tramway manager being president is the woollen city a particularly appropriate meeting place for tramway managers. The Bradford tramway system is one of the most important of the several networks, which for all practical purposes afford continuous tramway communication over a large portion of the West Riding of Yorkshire.

The differences in gauge, which unfortunately exist, have not so far materially affected the utility of these tramways, which are more or less a necessity of the times in the thickly-populated area which they serve.

Mr. Spencer's presidential address, which, of course, took precedence of other matters on Wednesday, touched briefly on a number of topics associated with tramway working. We pass over his reference to the now somewhat musty Board of Trade statistics for 1909, and join him in the more congenial and, indeed, far more important task of considering the future in regard to tramways.

In this connection the president notes that the amount of revenue received, other than passenger receipts, is in the ratio of 1 to 38, and having in view the congested state of the thoroughfares in many large towns due to slow-moving goods traffic, he urges that more should be made of the powers already possessed by tramways for carrying goods.

Unfortunately, congested street traffic is usually accompanied by congested tramways, and it is not very clear to the average man, how more cars are to be crowded on to some of the busy routes that the president's remarks call to mind. The more rural routes, which are not so encumbered with traffic, frequently offer scope for development in building up other than passenger traffic, but they appear to have escaped attention.

Both Bradford and Leeds are giving close attention to the carriage of goods on tramways, the former having suffered a temporary rebuff in a recent Parliamentary application for extended powers, and the latter having already entered into some large contracts for the carriage of material.

The President draws attention to the possibilities of the railless trolley system, which he says provides "a vehicle as reliable as a tramcar, and at least as cheap to operate, but with a capital expenditure on street work so low that the bugbear of heavy interest and sinking-fund charges is practically non-existent."

Here, again, both Bradford and Leeds have obtained similar powers for the installation of a railless trolley line.

With reference to accumulator traction, Mr. Spencer says :—

> I hear that some progress is being made towards the improvement of the accumulator, or storage battery (viz., reduction of weight per capacity). On the other hand, the traction motor and car equipment is also showing signs of improvement in several directions, but chiefly in the increase of efficiency so far as power consumption is concerned. The average traction motor designed, say, eight years ago, gave an electrical efficiency somewhat less than that of similar-sized motors used in stationary work. The introduction of commutation poles and improved methods of control has certainly improved equipment efficiency. Reputable makers are now prepared to guarantee 10 to 12 per cent. higher electrical efficiency of equipments than formerly.
>
> Truck development is also proceeding, and we have truck makers who tell us that with their particular trucks they will guarantee a saving of 10 to 15 per cent. in electrical energy, and so on. In various directions the tendency is to reduce the power used per ton of material propelled.
>
> The car equipment is, therefore, improving in the direction of greater energy consumption efficiency. I do not think it at all unthinkable that we shall be able to propel our cars in the future with, say, 50 per cent. less energy than at present. If, then, the accumulator of the future is, say, half the weight for same capacity, there should be interesting possibilities.
>
> Lest any member should think my 50 per cent. saving of power rather high, may I remind him that we are wasting by wearing away brake-shoes and tires about 40 per cent. of the energy we

supply to our cars. Regeneration or recuperation is not, in my opinion, quite dead, and the future should see progress in that direction.

Mr. Spencer is not quite sure that tramway men have the monopoly of transit in the streets, and cites the—so far as we have been able to ascertain—unfortunate example of motor-omnibus competition.

We gather from his concluding remarks that the Association is busily engaged in settling two rather vexed questions, viz., corrugation and the price of energy, a settlement of either of which will, we feel sure, bring a sigh of relief from many tramway managers.

Wednesday's proceedings also included papers by Ald. Flint, of Leicester, on "The First Decade of Municipal Tramway Working," and by Mr. J. W. Dawson, Assistant Engineer, Bradford Corporation Tramways, on "The Comparative Durability of Brake Shoes and Tires." Thursday's business included a paper by Mr. A. Baker, Birmingham Corporation Tramways, on "Tramways in Relation to Town Planning," and a report by Messrs. E. Cross, R. L. Acland, P. J. Pringle and T. R. Smith on the "Lubrication of Car Bearings," followed by a tramway tour to Halifax and the Association dinner in the evening. The Business Meeting this morning concludes the work of the Conference.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyne.—The T.C. has decided to relay the lines in Old Square and Grey Street.

Australia.—New South Wales.—The Melbourne correspondent of the *Money Market Review* this week gives full particulars of the New South Wales railway and tramways, and their operation during the year ended June 30th, 1910. We extract the following figures relating to the tramways, in connection with which, though there was an increase in gross receipts, there was a still greater increase in working expenses, so that the net return suffered a decrease. The following table shows some of the main elements of comparison with the previous year:—

Years ending June 30th—	1909.	1910.		
Miles open	151½	165¾	Inc.	14¼
Gross revenue	£1,097,565	£1,185,568	Inc.	£88,003
Working expenses ..	875,560	983,587	Inc.	108,027
Net earnings ..	£222,005	£201,981	Dec.	£20,024
Passengers carried ..	186,318,738	201,151,021	Inc.	14,832,283
Car-miles run	18,853,621	20,579,386	Inc.	1,725,765

Perth.—We are informed that the employés of the Perth Electric Tramways, Ltd., resumed work on 10th inst., and a portion of the cars started running on that day. The gross receipts to the 16th inst. were £1,097, estimated working expenses £709, and estimated net receipts £388.

Bath—Saltford.—The Bath Electric Tramways Co. have informed the U.D.C. that they intend applying to the B. of T. for a further extension of time for constructing tramways to Saltford.

Belfast.—An admirable little booklet has been prepared describing the principal features of the city and the beauty spots in its vicinity, with particulars of the routes to follow in order to visit them by electric cars. It is given free to visitors. The publishers are the Nomad Press, Belfast.

Blackpool.—The tramway accounts for the past municipal year show that the passengers carried were 9,013,539 against 8,138,569 in the previous year; car-miles run 1,009,331, against 945,229, an increase of 10·75 per cent. of passengers and 6·57 per cent. on the number of miles run. The traffic receipts for the year were £57,503, plus £1,196 from advertising, making a total of £58,699; the working expenditure was £34,359; gross surplus £24,340, equal to 8·61 per cent. on the capital outlay. Having set aside £14,909 to meet interest and sinking fund on the capital outlay, there was a disposable balance for the year of £9,431, as compared with £3,659 last year.

Continental Notes.—Spain.—La Société des Tramways de Barcelona a San Andres has applied for a concession to construct and work an electric tramway from the terminus of the Barcelona-Horta line to the old church of San Juan de Horta.

Italy.—It is proposed to convert the steam tramway between Pisa and Marina into an electric line, and to extend it from the last-named place to Leghorn.

Germany.—The Bergmann Electricitätswerk Gesellschaft, of Berlin, is interested in a scheme for the construction of an electrical tramway between Sulzbach and St. Ingbert, Bavaria.

The Allgemeine Electricitäts Gesellschaft has taken over, under a 30 years' lease, the working of the municipal central electric lighting station and the electric tramway system in the town of Konigsberg.

Croydon.—The B.C. Tramways Committee has decided to purchase five new cars, as the total number available—70—have all been in use lately at week-ends, leaving none in reserve.

Dundee.—The Tramway Employés' Union and Mr. Fisher, the manager of the Corporation tramways, are at loggerheads the former complaining that Mr. Fisher is not recognising their, Union, despite the Committee's assurances that this would be done. Mr. Fisher, in replying to the accusation, complained that the Union did not treat his letters in a proper manner, and alleged that, in one instance, they had so altered his letter as to convey a wrong meaning, and that this letter was then given to the public through the Press. He had assured them that when his letters were properly treated, he would reply by letter, and not until then. The Union's letter of complaint to the Tramways Committee was allowed to "lie on the table."

Hove.—The T.C. has discountenanced a proposal of the Brighton and Hove Omnibus Co. to adopt the railless trolley system for their electric omnibuses.

Irlam.—It is stated that the D.C. is to approach the Salford Corporation with a view to inducing that authority to continue its tramways from Peel Green to Irlam, a distance of three or four miles.

Keighley.—At Tuesday's T.C. meeting sanction was to be asked for the promotion of a Bill in Parliament authorising the Corporation to provide railless trolley vehicles from Utley to Cross Hills and Sutton Mill; from Stockbridge to Nab Lane; from Ingrow to Oxenhope; and from Goulbourne Street to Oakworth; also to provide and run motor-omnibuses from Eastburn Bridge to Cross Hills and Sutton Mill and to Oxenhope and Oakworth.

Manchester.—Mr. P. Percival, secretary of the Manchester Ratepayers' Association, wrote to the town clerk of Manchester, that the attention of the Association had been drawn to reports in the Press respecting the manufacture of tramcars by Manchester Corporation on their own premises, and asked where the necessary legal powers were to be found by virtue of which the work was carried on. The town clerk, in reply, referred to Sec. 20 of the Manchester Corporation Act, 1897, Sec. 8 of the Corporation Tramways Act, 1889, and Sec. 32 of the Tramways Act, 1900, but Mr. Percival pointed out that the Acts quoted simply gave power to "provide" cars, not to make them, and the Committee of the Ratepayers' Association considered that the Corporation was acting in excess of its statutory powers in carrying on the work of tramway construction; the question was one of law, and not of fact, and the reference of it to the Tramways Committee by the town clerk seemed unaccountable in the light of his being the legal adviser to that body and to the Corporation. The town clerk (Mr. T. Hudson) acknowledged the last letter, and stated that it would be laid before the Tramways Committee.

The general manager of the Manchester Tramways, Mr. M'Elroy, states that the whole question turns on the meaning of the word "provide." It is, he says, a very wide word, and can scarcely be taken as meaning not to make. If that were the meaning the Act would have expressly stated that the Corporation were not to make the cars. He adds that the Corporation are just completing the first 50 cars made by themselves. They only make the bodies, and buy the electrical equipment, &c. Apart from the question of local employment, which the construction of the cars in Manchester gives, he says they can build them substantially cheaper than they could buy them, so that the ratepayers get the advantage. Moreover, there is the important fact that they know exactly the condition of all the material put into the cars, which is an item of considerable importance. Hitherto the cars have been built at Loughborough, Preston, and Motherwell, and it is the experience of the Tramways Committee that a substantial saving can be effected by building the cars themselves. The advantages of the latter course are summarised under the following heads: (1) A substantial saving in cost; (2) The creation of a new source of local employment; (3) A guarantee of the best and most suitable material in construction. The advantages, he points out, are all on the side of the general body of ratepayers who are the ultimate owners of the tramway system, and who reap all the benefits of its successful enterprise. It is urged that the action of the Ratepayers' Association is only the expression of an unreasoning prejudice against municipal trading of any sort. It is pointed out that there is no local car-making industry which could undertake the work upon which the Tramways Committee have embarked, and there is, therefore, no opposition to private enterprise in Manchester. It is not anticipated that the action of the Ratepayers' Association will be followed up by an application for an injunction to restrain the Tramways Committee from the further construction of cars.

Mersey Electric Railway.—On the 14th inst. a cable breakdown occurred at the St. James' Street Station of the Mersey Electric Railway, causing a stoppage of half-an-hour. Accidents on this line have been extremely rare.

Rawtenstall.—The Board of Trade has formally sanctioned the borrowing of £35,933 in connection with the Whitewell Valley tramways.

Rochdale.—The Tramways Committee has decided to recommend the T.C. to lay a double track in Blackwater Street.

Southport.—A proposal has been made to the Local Tramways Committee respecting the establishment of a system for the collection and delivery of parcels in the borough.

Tasmania.—A Select Committee has been appointed by the House of Assembly to consider a proposal to construct an electric tramway connecting Hobart with Huonville, with a branch into Kingston.

Wigan.—The Tramways Committee is purchasing six new single-truck double-deck cars at a cost of £750 each.

TELEGRAPH and TELEPHONE NOTES.

Cheap Telegrams.—The subject of penny-a-word telegrams was brought before the Conference of Journalists at the Guildhall last week by Mr. J. Henniker-Heaton, who urged that the penny rate should be adopted throughout Europe as the first step.

Croydon. — Having failed in its action in the County Court, and in the appeal to the Railway and Canal Commission, the Croydon Borough Council decided on Monday, in the case of certain streets, to pay to the Postmaster-General the difference in cost between placing the proposed telephone lines underground and overhead. In the 15 roads concerned in the litigation the estimated extra cost totalled £632, but the Council selected a few of the principal roads for the benefit of underground wires, and for the privilege of having them thus put out of sight, £266 is to be paid.

Glasgow Central Telephone Exchange. — On the invitation of the Postmaster-General a representative company inspected the new Central Telephone Exchange situated in Waterloo Street Post Office buildings, on Monday last, 19th inst. A large party of engineers and others closely associated with the telephone and electrical industry travelled from London the previous evening by special saloon carriage on the invitation of the directors of the Peel-Conner Telephone Works, Ltd., the contractors for the installation. Before the inspection the visiting party were entertained at luncheon in the Central Station Hotel by Mr. Hugo Hirst, chairman of the Peel-Conner Company, who presided. In the unavoidable absence of the Lord Provost, Bailie T. Dunlop represented the Corporation of Glasgow, and among those present were Mr. A. M. Ogilvie, Assistant Secretary G.P.O., Sir John Gavey, Mr. C. H. Wordingham and other well-known engineers.

The chairman, in proposing the toast of "The Engineers of the Post Office," read a letter of apology for absence from Mr. Herbert Samuel, the Postmaster-General, who sent his cordial congratulations on the successful installation of the New Central Telephone Exchange. Mr. Hirst complimented the Post Office engineers on the courage they showed in placing the equipment of such an installation in the hands of a home manufacturer, and felt proud that this company had lent a hand in carrying out this policy. He pointed out that the work done by the firm, with the assistance of Mr. Conner, had already led to the spending of some £30,000 in wages in Manchester. Mr. Ogilvie, in reply, stated that the Central Exchange was only one of a series of new exchanges to be established in Glasgow, which, when finished, would make the system as efficient as any, not only in Europe but even in America.

Mr. Conner described the salient points of the new exchange, emphasising the details of the switchboard equipment, and concluded by proposing "The Corporation of Glasgow."—Bailie Thos. Dunlop, in responding, said that Glasgow took the credit of having assisted in the development of telephonic communication in Great Britain by arousing the powers that were to a fuller realisation of their responsibilities.

Mr. W. A. Smith proposed "The Health of the Chairman."

The party thereafter proceeded to Waterloo Street Post Office, where they were joined by the Lord Provost, and, under the direction of members of the staff, were shown over the installation. From Waterloo Street the visitors were driven to the General Post Office in George Square, where Mr. Webber, the Postmaster, and his staff, conducted the party over the trunk exchange. Here from 10,000 to 12,000 calls are dealt with every 24 hours, on about 260 trunk lines.

Lighthouse Telephones.—The Penzance Chamber of Commerce has resolved to take steps to hasten the equipment of lighthouses and coastguard stations with telephonic communication.

CONTRACTS OPEN and CLOSED.

OPEN.

Austria-Hungary.—October 1st. A copy of the specification issued by the municipal authorities of Mostar, for tenders for the installation of plant for the supply of electricity to the town, has been received in London from the British Consul. Tenders should be addressed to the Stadtmagistrat, Mostar, Bosnia-Herzegovina. The specification (in German) may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

The Austrian State Railway authorities in Lemberg have just invited tenders for an installation of electric lighting at the railway station at Tarnopol.

September 27th.—The municipal authorities of Magyarovar are inviting tenders for the concession for the electric lighting of the town.

Australia.—September 27th. Electric lamps for the P.M.G.'s Department in Victoria. See "Official Notices" August 12th.

October 4th.—Telegraph and telephone insulators for the P.M.G.'s Department in all States. See "Official Notices" August 12th.

October 4th.—Telegraph and telephone material, for the P.M.G.'s Department in Victoria. See "Official Notices" August 19th.

October 4th.—Telephone material, for the P.M.G.'s Department in Victoria. See "Official Notices" August 19th.

October 5th.—5,000 porcelain insulators, for the P.M.G.'s Department in New South Wales. See "Official Notices" August 19th.

October 17th.—Telegraph and telephone material, for the Deputy Postmaster-General, Hobart. Commonwealth High Commissioner's Office, 72, Victoria Street, London.

VICTORIA.—Telephone cable and insulators, for the P.M.G.'s Department in Victoria. See "Official Notices" September 2nd.

MELBOURNE.—H.M. Trade Commissioner for Australia (Mr. C. Hamilton Wickes) reports that tenders will be received at the office of the Deputy Postmaster-General, Melbourne, as follows:—October 18th, for 23 miles of telephone cable (Schedule No. 284), and 500 composition insulators (Schedule No. 374); October 25th, for 10,000 Cordeau insulators (Schedule No. 373).

TASMANIA.—October 17th. Telegraph and telephone instruments and material, for the P.M.G. See "Official Notices" September 2nd.

MELBOURNE.—October 25th.—Deputy Postmaster-General. Electric lighting material (Schedule No. 311). Deposit required with each tender. Local representation necessary. For copies of the specification and form of tender apply High Commissioner in London for the Commonwealth of Australia, 72, Victoria Street, S.W., where preliminary deposits may be paid.

Birmingham.—September 30th. 78,000 tons of coal for the generating stations of the T.C. R. A. Chattock, city electrical engineer and manager, 14, Dale End.

Chile. — September 30th. Three dynamos and searchlights, also machines and tools, for the Chilian Navy. See this column September 9th.

China. — SHANGHAI. — October 10th and 20th. The *North China Herald* of August 12th contains a notice to the effect that tenders are invited by the Shanghai Electricity Department for the supply of the following:—(1) Electric heating and cooking appliances (tenders October 10th); (2) 10,700 carbon-filament lamps (tenders October 20th); (3) 15,000 metallic-filament lamps (tenders October 20th). Sealed tenders, marked "Tender for Heating and Cooking Appliances," or as the case may be, should be addressed to the Acting Secretary, Council Rooms, Shanghai. Conditions, specifications and forms of tender may be obtained from the Electrical Engineer, Electricity Works, 31, Fearon Road, Shanghai, on payment for each specification of 10 taels, which will be returned on receipt of a *bona fide* tender.—*Board of Trade Journal.*

Copenhagen.—September 26th. Danish State Railways Administration; 1,656 accumulators for the lighting of railway carriages. Tenders, marked "Tilbud paa Levering af Akkumulatorer," at "Direktören for Maskinafdelingen, de Danske Statsbaner, Gl. Kongevej 1D, 3 Sal," Copenhagen. Specification and conditions of tender, &c. (in Danish), may be seen by British makers at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Devonport.—September 29th. Steam coal for 12 months for the Corporation Electricity Committee. Particulars from Mr. J. W. Spark, borough electrical engineer.

Edinburgh.—October 10th. Steam turbines, A.C. generators, condensing plant, and internal parts of cooling towers. See "Official Notices" September 16th.

Egypt.—October 20th. Electrical installation and refrigerating plant, for asylum at Khanka. Specification from Chief of Administrative Service, Public Works Department, Cairo; for particulars as to tendering see *Board of Trade Journal.*

October 31st.—According to the *Standard*, tenders are invited by the Ministry of the Interior, Cairo, for the supply and installation of machinery, &c., required for the establishment of water supply and electric light systems in the town of Beni-Souef. Tender forms obtainable from Mr. A. L. Webb, C.M.G., Queen Anne's Chambers, Westminster, S.W. The specifications, drawings, &c., may be obtained on payment of 200 piastres (£2 1s.). A deposit equal to 2 per cent. of the value of the offer is required with each tender.

France.—November 1st. The Prefect of the Department of the Yonne, at Auxerre, is inviting offers for the construction of a system of metre-gauge electric or steam railways in the Department, the aggregate length of the proposed lines being about 233 kilometres.

French Congo.—October 14th. The *Moniteur Officiel du Commerce* (Paris) contains a notice inviting tenders for the supply and laying of a submarine cable between Libreville and Loango (Pointe Noire). To qualify tenders a provisional deposit of 50,000 francs (£2,000) will be required, to be increased by the successful tenderer to 100,000 francs (£4,000). Tenders to the "Bureau de l'Ingénieur Chef des Etudes, Ministère des Colonies, Rue Oudinot No. 27," Paris.—*Board of Trade Journal.*

Halifax.—September 27th. Electrical fittings for the Board of Guardians for six months; Arthur T. Longbotham, clerk, 4, Carlton Street.

Isle of Thanet.—October 1st. Supply of general stores for the year for the Isle of Thanet Electric Tramways and Lighting Co., Ltd. See "Official Notices" September 16th.

London.—Hackney.—October 13th. 90,000 pairs of white open-type arc-lamp carbons, for the Electricity Department. See "Official Notices" to-day.

L.C.C.—October 5th. Electrical installations at Coroner's Court, Poplar, and Hoxton House Schools, Shoreditch. See "Official Notices" to-day.

Margate.—October 17th. Dust destructor, for the T.C. E. A. Borg, Borough Surveyor, 13, Grosvenor Place.

Metropolitan Railway.—October 3rd. General stores, including a number of electrical items, for 12 months. W. H. Brown, secretary, 32, Westbourne Terrace, London, W.

Morecambe.—The Electricity Committee require a new motor pump for boiler feed.

Mozambique.—October 12th. The authorities of the Harbour and Railway at Lourenco-Marques, Mozambique, are inviting tenders for the supply of seven electrically-operated cranes, ranging in capacity from 1 to 10 tons.

New Zealand.—December 15th. Installations of wireless telegraphy at Doubtless Bay, Gisborne, Cape Farewell, Sumner and Bluff. See "Official Notices" August 5th.

Norway.—September 30th. Tenders are invited for the supply to the Norwegian State Railways of two 35-ton electric cranes. In all Norwegian Government contracts a preference of from 10 to 15 per cent. (apart from Customs duties) is given to Norwegian manufacturers, and it is obligatory that a resident agent (not necessarily a Norwegian firm) should act for tenderers not residing in Norway. Tenders, marked "Löpekraner," to "Styrelsens for Statsbanernes Expeditionskontor," Christiania. Specifications, &c. (in Norwegian), may be seen by British firms at the Commercial Intelligence Branch of the Board of Trade.

Rhyl.—September 26th. Fuel oil for the U.D.C. Electricity Department for 12 months. Particulars from Mr. E. H. Wright, at the Electricity Works.

South Africa.—Durban.—September 28th. Elevated jet condenser and piping, switchboard, rotary converters, cables and transformers, for the Corporation. See this column last week.

Spain.—The municipal authorities of Belmez (Province of Cordoba) have just invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Swinton.—The U.D.C. has decided to invite tenders for the overhead portion of the work in connection with the supply of electricity to the Industrial Schools.

Uruguay.—September 30th. The equipment of an electric generating station and the supply of electric light at San Fructuoso. See this column September 9th.

Walthamstow.—The U.D.C. has decided to invite tenders for a new battery for the electricity station.

York.—October 7th. Carbons, carbon brushes, incandescent lamps, meters, motors and accessories, for the Electricity Department. See "Official Notices" to-day.

CLOSED.

Australia.—According to our contemporary, the *Australian Mining Standard*, the following tenders were received by the Sydney Municipal Council for high and low-tension switchgear:—

Ferranti, Ltd.	£2,720	Australian General Elec. Co.	£3,137
Noyes, Bros.	2,813	Siemens Bros., Ltd.	3,561

Belgium.—La Société Cuivre et Zinc, of Liége, succeeded last week in submitting the lowest tender to the Société Nationale des Chemins de Fer Vicinaux, of Brussels, for the supply of the bronze trolley wire required during the year ending September 30th, 1911. Nine other concerns competed for the order, including the British Insulated and Helsby Cables, Ltd., and Messrs. T. Bolton and Sons, Ltd. For the supply of the electrical rail connections required for the same period, the lowest offer was that of Messrs. Felten & Guilleaume, of Mulheim-am-Ruhr, Germany.

Birkenhead.—The T.C. has accepted the tender of Messrs. Willans & Robinson, Ltd., for a mixed-pressure steam turbine, coupled to a direct-current generator of the Electric Construction Co.'s make, at £2,917.

The Corporation has placed an order with Messrs. Ed. Bennis and Co., Ltd., for three sets of Bennis high-duty, smokeless and gritless coking stokers and compressed-air furnaces, for Lancashire boilers at its pumping station.

Bournemouth.—The T.C. has accepted the tender of Messrs. Wm. Griffiths & Co., Ltd., for the construction of the Poole track, at £5,947, and the Wimborne Road track, at £2,506.

Bristol.—The T.C. has accepted the tender of the City Glass Co. for arc lamp globes for a year, at £38 15s.; and that of Siemens Bros. Dynamo Works, Ltd., for extra-high-tension, low-ension, and direct-current switchgear at the Dock sub-station, at £204 15s.

British Columbia.—Messrs. James Gordon & Co., of 83, Knightrider Street, E.C., water power engineers, report that they have received orders from British Columbia for three spiral-cased Francis turbines, each to give 950 H.P. under a fall of 120 ft. These are being supplied, together with patent oil-pressure governors, throttle valves, and other accessories, for direct coupling to A.C. generators.

Crewe.—The T.C. has accepted the tender of Messrs. Carrington & Button, of Crewe, for installing the electric light at the new boys' school and extension at Bedford Street, at £147.

Government Contracts.—The following tenders have been accepted during the past month by the Government departments named:—

War Office.

Rewinding crane motors, &c.—Lancashire Dynamo and Motor Co., Ltd.
Switchboards, &c. (Aldershot electricity supply).—British Westinghouse Electric and Manufacturing Co., Ltd.
Turbine, steam, &c. (Aldershot electricity supply).—Willans & Robinson, Ltd.
Internal wiring of sculleries, married quarters, Aldershot.—Electric and General Lighting Engineering Co.

India Office Store Department.

Carbon brushes.—Lancashire Dynamo and Motor Co.
Motors.—Laurence, Scott & Co.
Telephones.—British L. M. Ericsson Manufacturing Co.
Transmitters, &c.—Elliott Bros.

General Post Office.

Cable, paper core.—Callender's Cable and Construction Co., Ltd.; Johnson and Phillips, Ltd.
Coils, retardation.—Western Electric Co., Ltd.
Copper wire.—T. Bolton & Sons, Ltd.; British Insulated and Helsby Cables, Ltd.; Elliott's Metal Co., Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. and Smiths, Ltd.); Wilkes, Sons & Mapplebeck, Ltd.
Electric fans (11), at King Edward Building, G.P.O., E.C.—Davidson and Co., Ltd.
Electric lifts (8), at the Head P.O., Edinburgh.—A. W. Penrose & Co., Ltd.
Cast-iron pipes and earthenware ducts in Glasgow (Royal and Dougal's Telephone Exchange areas).—W. Dobson.
Cast-iron pipes and earthenware ducts in Glasgow (Bridgeton Telephone Exchange area).—W. Dobson.
Cast-iron pipes between Worcester and Gloucester.—Section 1, Bennie and Thompson; Section 2, Hodge & Sons.

Office of Works.

Electrical work, Victoria and Albert Museum and new Meteorological Office: electric mains.—Messrs. Siemens Bros. & Co., Ltd.
Generating set, South Kensington generating station.—Messrs. Browett, Lindley & Co., Ltd.

Hitchin.—For installing the electric light at the Town Hall, the U.D.C. has received the following tenders:—

J. Smallwood (accepted), £65; P. T. King, £70; Slater & Batty, £84.

Kettering.—The U.D.C. has placed an order with Messrs. Ed. Bennis & Co., Ltd., for three independent coal elevators for feeding the hoppers of Bennis stokers on three Lancashire boilers at the electricity works.

London.—The L.C.C. received the following tenders for wiring the central car-repair depôt (second section):—

The Central Motor Engineering Co.	£1,571
E. Lawrance & Sons, Ltd. .. .. (accepted)	1,703
G. E. Taylor & Co.	1,864
Johnson & Phillips, Ltd.	1,877
Tilley Bros.	1,889
E. Newbald & Co.	2,024
Pinching & Walton	2,035
G. Weston & Sons, Ltd.	2,044
Gordon Lawson	2,320
Barlow Bros. & Co.	2,426

Southwark.—The B.C. has accepted the tenders of the following for the supply of cable:—

British Insulated and Helsby Cables Co., Ltd.—220 yards ·8 triple concentric cable, £105.
Western Electric Co., Ltd.—440 yards ·1 triple concentric cable, £88; also 440 yards ·05 cable, £60.

Rawtenstall.—The following tenders have been accepted in connection with the Whitewell Valley tramways:—

Crompton & Co.—Negative booster.
Whipp & Bourne.—Additional switchboard panels.

Roumania.—The Siemens-Schuckertwerke Gesellschaft, of Berlin, has submitted the lowest tender to the municipal authorities of Focshani for the establishment of a central electric lighting station in the town.

Wakefield.—The B. of G. has accepted the tender of the Wakefield Electrical Engineering Co. for electrical work for six months.

West Ham.—The Education Committee has accepted the tender of J. T. Halsey, at £288, for the electric lighting of West Silvertown School.

Whiteabbey.—Messrs. Coates & Son, Belfast, have secured the contract for the lighting of the Sanatorium with electricity. The generators will be driven by oil engines.

FORTHCOMING EVENTS.

The North of England Institute of Mining and Mechanical Engineers.—September 23rd. Excursion to Blackhall Colliery.

Association of Engineers-in-Charge.—September 24th. Visit to the Naval Mercantile Marine and Engineering Exhibition, 5.15 p.m. Lecture on "Wireless Telegraphy; its Maritime Importance," by G. Langler Bullock, 7.45 p.m.

Iron and Steel Institute.—September 26th to 30th.—Autumn meeting, at Buxton.

NOTES.

Electrical Contractors' Association.—At a meeting of the Newcastle branch of the Electrical Contractors' Association, held on the 13th inst., an interesting discussion occurred concerning the question of municipal trading, more especially in relation to the Bill which is being promoted by the Incorporated Municipal Electrical Association for the purpose of giving power to local authorities to effect the sale of electrical appliances and fittings, and to carry out installation work. It was pointed out that many Corporations were supporting the Bill, some of this support being financial, while Members of Parliament were being approached with a view to support in Parliament. It was decided that Members of Parliament in the area surrounding Newcastle ought to be informed concerning problems of municipal trading from the electrical contractors' point of view, and that the general public should also have the case put before them. Among other bodies which it was suggested should be approached were the Newcastle-upon-Tyne and Gateshead Chamber of Commerce, the Trade Protection Society and the Ratepayers' Association. It was also pointed out that a complete collection of facts relating to the measure of success or otherwise of municipal wiring schemes, &c., should be made for the purpose of this campaign. Although in Newcastle itself the situation was dominated by private companies, there were certain areas, such as Fenham and Benwell, which possessed their own lighting powers, and work in these areas might possibly be affected by such legislation. The recent deputation from Sunderland to visit West Ham and Marylebone was commented upon, while it was pointed out that Mr. J. H. Cawthra, the borough electrical engineer of South Shields, had presented a report to his Committee supporting the proposed Bill, and this report had received an approval of that Committee. It was decided by this branch of the Electrical Contractors' Association to place their views upon the matter before the public in such ways as were feasible at an early date.

Glasgow Smoke Abatement Exhibition.—In the Electricity Section of the Smoke Abatement Exhibition now being held in Glasgow, there is an interesting display. Messrs. Mavor and Coulson, Glasgow, have two heavy motors on view—one for use in engineering works, and a vacuum cleaner. Messrs. Primrose and Primrose, Glasgow, show an electrical generating plant, consisting of paraffin motor directly-coupled to a dynamo, and storage batteries. This firm also show an iron and stand for boiling or frying, and a variety of electrical necessaries. The General Electric Co., Ltd., have staged everything that is new in shop light reflectors and lamps up to 1,000 c.p. They have also a wide choice in heaters and cookers. The Beck Flame Lamp Co. have an excellent stand, and their exhibit comprises both flame lamps for lighting streets, yards and works, and also indoor lamps. The Simplex Conduits, Ltd., make a special feature of "Holophane" glassware, also their "Silundum" system of electric cooking, besides, in their heating section, a range of radiators and convectors. Messrs. Watson and Whyte exhibit for Spagnoletti, Ltd., the electric water heater "Therol." Messrs. Malcolm & Allan, Glasgow, show "Tricity" ranges and cookers. The British Thomson-Houston Co. have a show of domestic utensils on the stand of Mr. Alexander Lindsay, who also displays the electric motor, "Mary Ann," the "Borlase Matthews" patent. Electrical fittings and shop signs are on view by Messrs. Wm. McGeoch & Co., who also exhibit a variety of heaters. Messrs. Woodward & Co. show the Westinghouse Auriga and tantalum lamps, and Messrs. William Kemp & Co. also have a good exhibit of fittings. Among the heaters is seen the "Electroyl" heater on Messrs. Potter & Co.'s stand.

Copper.—Mid-monthly statistics (Messrs. H. R. Merton and Co.'s circular) show withdrawal from stock of 1,841 tons during the first fortnight of September. This considerably exceeds the rate of 2,658 tons which is the average withdrawal per month since February. As the stock of furnace material at Liverpool and Swansea has increased 291 tons, and that afloat from Chile is heavier by 225 tons, the actual withdrawal comes out even higher, viz., 2,357 tons. The American stocks are not quoted for the mid-month. The supplies are low to English ports from that country; the same may be said of the American supplies to the whole of Europe. Spain, with 1,051 tons is, so far, above the average. Shipments from Chile are average, and Australian slightly over. The total deliveries, compared with the two preceding months, do not, so far, indicate very heavy trading, but this is, of course, subject to alteration during the second half of September. The price, still showing some falling off, would seem to indicate that American stocks are still plentiful.

Electricity is Life.—The question of electric lighting is being discussed in Graaff-Reinet, Cape Colony. The local paper, however, adds a word of warning, as follows:—

"Electric lighting adds a new possibility to the category of street accidents. Should a pole get upset, there will be the danger of a 'live' wire perhaps. Still, it will be a refreshing change to have an additional live thing in the town."

Dublin Electricity Staff Concert.—The employés' social reunion of the Dublin Corporation Electricity Supply Department was held at the Grand Hotel, Dublin, on Thursday, 15th inst. The Right Hon. the Lord Mayor took the chair, and with him were the chairman of the Lighting Committee, Ald. Dr. McWalter; Mr. Mark Ruddle, city electrical engineer; Mr. G. Archer, chief assistant; Mr. L. J. Kettle, superintendent of Pigeon House generating station; and Mr. E. Mayne, mains engineer. The chairman, in opening the proceedings, congratulated the company on the fact that their first "smoker" was so remarkably well attended. Mr. Jas. Lurring acted as accompanist, and the following artistes assisted, viz., Messrs. T. H. Lurring, R. Beatty, Gilbert Archer, J. Moran, E. Dempsey, R. Carrell, R. Lurring, J. Reilly, T. O'Brien, C. O'Reilly, J. Kirwan, J. E. Whelan, &c. The Fortune Quartette (mandolinists) delighted the audience, and the comic element was supplied by the well-known Chris Bruton and Mr. M. Garrett. In bringing the proceedings to a close, the Lord Mayor paid a special tribute to the energy displayed by the Managing Committee and its assistants and to the splendid talent procurable in the Dublin Electricity Department. A really enjoyable night was brought to a close by drinking the healths of Messrs. Ald. M'Walter, Ruddle, Archer, Kettle and Mayne. The Managing Committee were Messrs. T. H. Lurring, F. Foster and F. Sheehan, with Messrs. H. J. Mayne and J. McNamee, hon. secretaries, the stewards being Messrs. H. Donohue, J. Melia, J. Keogh and J. Reilly.

A Bermondsey Appointment.—The Bermondsey Borough Council on Tuesday night was requested to appoint to the post of third engineer at the electricity works Mr. C. J. Oake, the son of Councillor W. J. Oake, the chairman of the Electricity and Street Lighting Committee. It was only in March last that Mr. C. J. Oake was appointed junior engineer and switchboard attendant at a salary of 38s. a week. He is 21 years of age, and his proposed appointment would increase his salary to £110 a year, rising by annual increments of £10 to a maximum of £130.

Mr. T. Hansom elicited from the chief engineer of the electrical station that Mr. C. J. Oake had met with an accident through connecting the wrong voltage to a lamp, the result being that the wire fused and the lamp burst. This the engineer described as "an error of judgment."

Alderman Wills proposed that the committee advertise the vacancy in the usual way. He held that to put a young man of Mr. C. J. Oake's years in such a responsible position would not benefit the undertaking or tend to the safety of the community. He had made a blunder which a man of experience would not have made.

Mr. E. Stickland, in seconding, maintained that no son of a councillor should be put in a position of responsibility under the Council. Councillor W. J. Oake had been chairman of the Electricity and Street Lighting Committee for five years, and he should not have proposed his own son's appointment.

The Mayor: That is hardly fair.

Mr. Stickland: Blood is thicker than water. It was a very great tactical error on his part.

Ald. Harford maintained that the accident to young Mr. Oake did not show he was not qualified for the post.

Mr. W. J. Delderfield said if Master Oake had not been Councillor Oake's son he would not have stood a chance of being originally selected to appear before the Council for the post of switchboard attendant. In view of the accident that had occurred, they must consider the public safety, and see that the electric undertaking was not jeopardised.

Mr. W. J. Oake said that, as the parent of the young man who had been addressed as "Master" Oake, he held that he was quite as capable of carrying out any business as well as any member of the Council, though some of them had grey hair. He did not wish to press the appointment of his son if the Council did not think he was worth the post. As a marine and seafaring man, he (Councillor Oake) maintained that his son was fully competent to fill the post, and defied anyone with any experience to say he was not a fit and proper person.

The Rev. Kaye Dunn said that, after the speech they had just heard, there was not a man on the Council who did not realise that a father had been pleading for his son, Such a spirit must be banned. It was Tammany—the absolute spirit of Tammany—a father pleading for his son to be appointed to a position under the Council, his father being chairman of the committee controlling the work. They wanted no jobbery of this kind. If it was right for Mr. Oake to have his son appointed to a position on a depôt of which he was chairman, it was right for all chairmen of committees to have their sons appointed to positions under them. What a delightful family party they would be!

By 29 votes to 15, the Council rejected the Committee's recommendation, and agreed to advertise for applicants for the vacant appointment.

Tramcar Speed Indicators.—According to the September number of the *Official Circular of the Tramways and Light Railways Association*, a meeting of the Special Committee, which is considering the question of speed indicators for tramway cars, was held before the holidays. It was reported that out of a total of 24 firms who replied to the Committee's invitation to submit instruments for trial purposes, 15 had accepted the conditions laid down by the Committee, and their respective indicators were now being tried on various tramway systems. It was decided that the various reports should be sent in by the end of November, when the Committee will prepare its final report to the Council. When approved, this report will be submitted to the Board of Trade.

Lift Fatality.—An inquest was held at Westminster Coroner's Court on 16th inst. into the death of Henry James Boulton, 31, an electrician. From the evidence, it appeared that whilst deceased was employed putting some electric wires into an office at 37, Strand, he had occasion to place his head over the lift bar to inspect the lift well. As the lift attendant was unaware what he was doing, the lift was set in motion, and Boulton was struck on the back of the head by a 30-cwt. counter-balance weight, and killed instantly.

E.C.C. Employés' Hospital Fund.—The Workpeoples' Hospital Committee in connection with the Electric Construction Co., Ltd., Bushbury, held their annual meeting on Wednesday in last week, and distributed the funds, £126, which they had collected during the year, to a number of hospitals and institutes.

Educational Notices.—We have received some particulars of the Ecole Spéciale des Travaux Publics, one of the branches of which is devoted to the applications of electricity, at Arcueil-Cachan, near Paris. The school appears to be admirably equipped for the training of engineering pupils, who are, moreover, obliged to acquire experience in works before they can obtain the diploma of "Ingénieur," and, it is stated, are in great demand.

University College, London.—The Session in the Faculty of Engineering begins on October 3rd. In addition to the regular undergraduate courses, the following postgraduate courses will be given during the coming term:—

Steam Turbines (supplementary to course in session 1909-10), by Mr. E. G. Izod, of Messrs. Willans & Robinson, on Fridays, at 5.30, beginning October 21st.

Railway Engineering, by H. Deans, M.Inst.C.E., of the Great Western Railway, on Mondays and Thursdays, at 5, beginning October 6th.

Electrical Design, by H. M. Hobart, M.Inst.C.E., on Mondays, from 5 to 7, beginning October 10th.

University of Liverpool.—The new session of the Faculty of Engineering commences on October 4th; full particulars of the courses of study are given in the prospectus recently issued. Dr. E. W. Marchant is the Professor of Electrical Engineering.

Municipal School of Technology, Manchester.—The Calendar of this, one of the most admirably equipped schools of technology in the world, contains a mass of information regarding its resources and advantages, and the various courses of instruction provided for both day and evening students. Prof. A. Schwartz is the head of the Physics and Electrical Engineering Department, his colleagues including Prof. W. W. H. Gee, and Messrs. C. F. Smith, W. Cramp and J. Lustgarten. Facilities are given for obtaining engineering degrees at Victoria University.

Northampton Polytechnic Institute.—We have received the "Announcements" of this Institute, containing full details of the day and evening courses in engineering, electrochemistry, technical optics, and other subjects; the engineering courses include automobile work, aeronautics and radiotelegraphy, and there are evening courses in metallurgy. The evening classes commence on the 26th inst., and the day classes on October 3rd. A new electrical generating station has been installed this year at a cost of £6,000, and will be formally opened on October 12th. The head of the electrical engineering department is Dr. Walmsley, with whom is associated Mr. F. M. Denton, Dr. Drysdale's successor.

South-Western Polytechnic.—The calendar and prospectus of this college has just been issued, and gives all necessary information regarding the curricula provided for day and evening students in electrical engineering and other subjects. Mr. A. J. Makower is the head of the electrical department.

City of London College.—A special feature of the evening classes of this college is the attention given to commercial subjects. Banking, accountancy, modern languages, and other matters of importance in business are taught, and courses are arranged leading to the degree in commerce of the University of London.

Borough Polytechnic Institute.—The prospectus for the session, which has just come to hand, gives particulars of the commercial and technical courses provided, which include engineering and electrotechnics, the workshops and laboratories being well equipped for the purpose. The head of the Physics and Electrotechnics Department is Dr. J. Henderson. The electric wiring courses have been rearranged, and new classes have been instituted in Mechanical Engineering. The Institute also includes technical day schools, founded for the training of boys and girls in various trades. The session begins on Monday next.

Institution and Lecture Notes.—The Institution of Municipal Engineers.—The second annual meeting of this Institution is to be held at Eastbourne on Friday and Saturday, October 7th and 8th.

Institution of Electrical Engineers (Manchester Local Section).—On Friday, October 14th, a conversazione will be held at the Whitworth Institute to open the new session.

Association of Mining Electrical Engineers.—In connection with the efforts which have recently been made to form in Scotland two branches of the Association, a representative meeting of those engaged in the application of electricity to mining was held at Glasgow on Saturday last. Mr. H. W. Clothier, Newcastle-on-Tyne, presided at the outset, supported by Mr. J. Glynn Williams, Whitehaven, both gentlemen being present as a deputation from the General Council of the Association. The Chairman explained the objects of the Association, and stated that it had now close on 700 members, and already branches had been formed in eight different centres. Mr. J. Glynn Williams read a communication from the President of the Association, Mr. Wm. Maurice, Notts., in which the latter said he thought it might be taken as an axiom that in the immediate future there would be no place in any part of a colliery for the man who knew nothing of the rudiments of electrical working. Members of Council were then appointed, with Mr. A. Anderson, Motherwell (Messrs. Anderson & Boyes), as chairman, and Mr. D. Martin, 12, Waterloo Street, Glasgow, as secretary. In intimating that, as the outcome of the meeting, the membership of the Glasgow branch had been increased to upwards of 50, Mr. Williams called attention to the meeting to be held in Dunfermline to-morrow, with a view to forming a branch in the east of Scotland.

Tramways Jubilee.—On Friday last the Metropolitan Association of Electric Tramways Managers gave a dinner at Whitehall Court to celebrate the jubilee of tramways in Great Britain. Mr. H. S. Blair presided, and Sir Clifton Robinson, who was present at the opening of the first tramway on August 30th, 1860, at Birkenhead, was one of the guests.

The Cable-Makers' Association.—On Wednesday, 21st inst., the above Association removed to Princes Mansions, 64, Victoria Street, S.W., and all communications should be sent there in future. The telephone number and telegraphic address remain unaltered.

Appointment Vacant. — Switchboard attendant for Eccles (15s.). See our advertisement pages to-day.

Inquiry.—Makers of the Riefler electric clock are asked for.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Taunton T.C. has appointed Mr. T. J. Considine as charge engineer at the electricity works.

Mr. F. R. Batty, late manager of the Northallerton Electric Light and Power Co., who has obtained a position in London, has been presented by the directors of the company with a cheque in appreciation of his services, and by the staff with silver flower vases.

Mr. R. B. H. Cragg, second engineer in charge to the Bermondsey undertaking, has resigned, he having been appointed chief assistant engineer at Watford. Mr. Ingram, third engineer in charge at Bermondsey, is to be promoted to the position of second engineer in charge at a salary of £120 per annum, rising by annual increments of £10 to £140. Mr. Oake, junior engineer in charge and switchboard attendant, was recommended to take Mr. Ingram's place at a salary of £110 per annum, rising by increments of £10 to £130, but the Council has had a discussion on the matter, which we report on the previous page. Mr. Isaac Day was recommended for the post of junior engineer in charge and switchboard attendant.

Tramway Officials.—On Friday last Mr. W. E. Hardy, the resident general manager of the Bath E.T. Co., to whose marriage we referred last week, was presented by the employés of the company with two very acceptable gifts. The staff, inspectors, motormen, and conductors presented a Chippendale grandfather striking clock, 120 years old. The engineering staff presented Mr. Hardy with a recording barometer (barograph).

General.—It is announced that Mr. J. E. Kingsbury, formerly general manager in London of the Western Electric Co., has joined the board of the Western Electric Co., Ltd. We offer our congratulations both to Mr. Kingsbury and to the company with whose interests in this country he has been so long and so closely identified.

Mr. Alfred Slatter, M.I.E.E., has just returned, per the *Oceanic*, from a trip to Mexico and America, where he has been engaged in examining some electric power and light projects.

The marriage took place at Cricklewood on September 17th, of Mr. S. W. Corns, A.M.I.Mech.E., chief draughtsman of the electrical and mechanical engineering departments of the Metropolitan Railway, and Miss Teresa Carlotta Sofietti, of Cricklewood. The presents included a carved oak smoker's cabinet from the drawing office staff, and a set of spoons and forks, &c., from the members of the works staff.

Mr. W. Vincent Waite, late works manager to Messrs. Bruce Peebles & Co., Ltd., was the guest at a complimentary dinner given in Edinburgh on 14th inst. on the occasion of his leaving the firm to start business on his own account in Cardiff. Earlier in the day Mr. Waite was presented with a sideboard and Mrs. Waite with a silver salver, as a token of appreciation from the workmen and staff. The presentation was made in the main shop by Mr. Lee Murray, the general manager of the company, and Mr. Waite feelingly replied. Mr. W. A. Scott, formerly assistant works manager, has been appointed to fill the vacancy created by Mr. Waite leaving the firm.

The Electrical Review offers its congratulations to Mr. John Eldon Bankes, K.C., upon the honour he has received in his promotion to be one of the judges of the High Court. Some of our readers will remember that about 17 years ago, when this journal was engaged in its successful litigation connected with certain electric belt exposures, Mr. Bankes rendered splendid service as one of our counsel. That suave and courtly, and irresistibly masterly manner, which has had much to do with his success at the bar, will go far to ensure for him a brilliant continuation of his career upon the bench.

Will.—It is announced in the daily Press that the late Mr. George Flett, contractor, managing director of Messrs. Dick, Kerr & Co., Ltd., who died at Birmingham on July 27th, from the effects of a motor-car accident, left estate valued at £111,653 gross, with net personalty £88,775.

NEW COMPANIES REGISTERED.

Electric Power Plants, Ltd. (111,672).—This company was registered on September 9th, with a capital of £15,000 in £1 shares (10,000 preference), to carry on the business of manufacturers of and dealers in and contractors for electric plants, turbines and apparatus, suppliers of electricity for light and power, &c., and to adopt an agreement with A. H. Gibbings and P. J. Mitchell. The subscribers (with one preferred share each) are:—C. O. Bastian, 91-93, Palmerston House, E.C., electrical engineer; A. H. Gibbings, 17, Gambier Terrace, Liverpool, engineer; P. J. Mitchell, Caxton House, Westminster, S.W., engineer; H. W. Horsman, Caxton House, Westminster, S.W., clerk; D. Bennett, Caxton House, Westminster, S.W., engineer; J. F. Mitchell, 16, Hilgrove Road, South Hampstead, N.W., accountant; W. W. Griffiths, 7, Dickerage Lane, New Malden, Surrey, clerk. Minimum cash subscription 33⅓ per cent. of the shares offered to the public. The number of directors is not to be less than three, or more than five; the first are P. J. Mitchell, C. O. Bastian and A. H. Gibbings; qualification, £20; remuneration, £50 per annum. Registered office, Caxton House, Westminster.

Electric Fire Prevention Appliances and General Manufacturing Co., Ltd. (111,671).—This company was registered on September 9th, with a capital of £1,000 in £1 shares, to carry on the business of electricians, mechanical engineers, manufacturers and makers of electricity, motive power and light, manufacturers of and dealers in apparatus and appliances, &c. The subscribers (with one share each) are:—W. H. Cook, 60, Aldermanbury, E.C., engineer; W. Sullivan, 19, Stavordale Road, Drayton Park, N., stenographer. Private company. The number of directors is not to be less than two or more than five; the first are not named. Table "A" mainly applies. Company's borrowing powers unrestricted. Registered by H. Dade & Co., 14, Queen Victoria Street, E.C.

Nuneaton Electrical Contracting Co., Ltd. (111,703).—This company was registered on September 12th, with a capital of £1,000 in £1 shares, to carry on in Nuneaton or elsewhere the business of dealers in electrical fittings and appliances, electrical engineers, &c. The subscribers (with one share each) are:—G. Cross, Newdegate Street, Nuneaton, ironmonger; G. R. Clay, 12, Market Place, Nuneaton, chartered accountant. Private company. The number of directors is not to be less than two or more than four; the first are F. Frankland and G. Cross. Registered office, Abbey Gate, Nuneaton, Warwickshire.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

C. H. Hare & Son, Ltd. (110,911).—Equitable mortgage dated August 31st, 1910, to secure £200 and further advances not exceeding £2,800, charged on certain leasehold land in Kings Road, Hay Mills, Worcester. Holders: Lamson Paragon Supply Co., Ltd., Paragon Works, Canning Town.

London Sherardising Co., Ltd. (89,533).—Debenture dated August 31st, 1910, to secure £270, charged on the company's undertaking and property, present and future. Holders: London and County Advance and Discount Co., Ltd., 57 and 58, Chancery Lane, W.C.

F. Burks & Co., Ltd. (106,099).—Issue on July 8th of £480 debentures, part of a series of which particulars have already been filed.

Electrical Contracts and Maintenance Co., Ltd. (101,757).—Issue on August 4th of £200 debentures, part of a series of which particulars have already been filed.

Foster Arc Lamp and Engineering Co., Ltd. (94,371).—Charge on certain land, &c., in Morden Road, Merton, dated September 2nd, 1910, to secure all moneys due, or to become due, from company to London, County and Westminster Bank, Ltd., 41, Lothbury, E.C.

Appleby Crane and Transporter Co., Ltd. (107,620).—Disposition in security dated August 19th (supplemental to trust deed dated July 15th, 1910, securing £125,000 5 per cent. first mortgage debentures). Property charged: Land in Shettleston and Glasgow, with buildings and machinery thereon. Trustees: D. Vickers, Cantley Hall, Doncaster; and J. R. Heckley, River Don Works, Sheffield.

Crompton & Co., Ltd. (27,200).—Return dated August 11st, filed August 16th, 1910. Capital, £300,000 in £3 shares; 85,000 shares taken up; £3 per share called up on 83,000; £249,000 paid; £6,000 considered as paid on 2,000 shares. Mortgages and charges: £175,000.

CITY NOTES.

Dick, Kerr & Co., Ltd.

According to an abstract of the directors' report in the financial Press, the profits earned during the 12 months' trading to June 30th, 1910, amount to £22,820. Out of this has had to be paid debenture interest and trustees' fees, and there has been reserved the sum required to provide for the premium payable on the redemption of the present debenture stock. These items absorb £12,404, leaving a balance of £10,416, to which must be added the profits brought forward from last year—viz., £63,141—making a total of £73,558 available for appropriation as under: To pay a dividend of 6 per cent. per annum on the preference share capital (the proportion of this dividend to December 31st, 1909, has already been paid), £18,300; to pay a dividend of 5 per cent. on the ordinary share capital of £260,000 (to be paid less income-tax), £13,000; to carry forward the balance of £42,258. The dividend on the preference shares will be paid on October 1st, 1910, as usual, and the dividend recommended on the ordinary shares will be paid on same date if approved by the shareholders. The warrants will be posted on September 30th. The directors regret that the severe competition referred to in the last annual report has continued throughout the past year.

Allgemeine Elektricitäts Gesellschaft.

The directors have just announced the financial results for the year ended with June 30th, 1910. After deducting administrative expenses, taxes, interest on loans and depreciation, the accounts show an available surplus, which has again been exclusively derived from manufacturing and sales, of £921,000, as compared with £819,000 in 1908-9. The profit on securities mentioned in the last report as brought over from the previous year has been devoted to depreciation, and the not inconsiderable profit obtained in the past year on account of securities and community transactions has again been carried forward to the new financial year. It is proposed to recommend at the general meeting to be held on October 15th, a dividend at the rate of 14 per cent. on the ordinary capital of £5,000,000, as compared with 13 per cent. in the preceding year. Besides the depreciation calculated according to the usual custom, it is intended to allocate £50,000 to increasing the reserves and to provide a further sum of £50,000 as reserve for the coupon tax. The turnover in the first two months of the new financial year, including the orders on hand, amounts to £12,350,000, as against £10,200,000 in the equivalent period a year ago. The proposals in regard to the previously announced transaction with the Felten and Guilleaume-Lahmeyer Works Co. will be submitted for decision at the ordinary meeting.

The course of the dividends and capital movements in recent years is illustrated by the following figures:—

	Share capital.	Dividend.
1896-7	£1,250,000	15 per cent.
1897-8	1,250,000	15 ,,
1897-8	500,000	7½ ,,
1898-9	2,350,000	15 ,,
1899-1900	2,350,000	15 ,,
1899-1900	650,000	7½ ,,
1900-1901	3,000,000	12 ,,
1901-1902	3,000,000	8 ,,
1902-1903	3,000,000	8 ,,
1903-1904	4,125,000	9 ,,
1904-1905	4,300,000	10 ,,
1905-1906	4,650,000	11 ,,
1906-1907	5,000,000	12 ,,
1907-1908	5,000,000	12 ,,
1908-1909	5,000,000	13 ,,
1909-1910	5,000,000	14 ,,

It will be seen that since the critical period in the electrical trade at the opening of the present century, the progress in the rate of distribution has been practically constant.

British Thomson-Houston Co., Ltd.

The directors' report for the period of 12 months from April 1st, 1909, to March 31st, 1910, states as follows:—

Works at Rugby.—The buildings and machinery of the company have been maintained in first-class condition during the year. A number of improvements and additions have been made, the most important being an extension to the incandescent lamp factory costing £19,000, practically doubling its size and capacity, and an extension to the main factory (largely to take care of the increase in the turbine business) now approaching completion, costing approximately £30,000. Another building is being enlarged, the estimated cost being about £11,000.

Curtis Steam Turbines.—The turbine business of the company continues to give satisfactory results, and many important orders have been executed during the year.

Metallic-filament Lamps.—The company has made further satisfactory progress in the development of metallic-filament (tungsten) lamps, and, to meet the increasing demand, has extended its manufacturing facilities as above-mentioned. Following the example of the General Electric Co., of New York, this company has adopted and registered "Mazda" as its trade-mark for tungsten lamps. The company has exchanged licenses with the Osram Lamp Works, Ltd. on all its metallic-filament lamp patents.

Debenture Redemption.—Under the terms of the trust deed securing the issue of the company's debentures, the company had to pay to the trustees on February 28th last the sum of £3,339 to be applied by them in purchasing debentures in the market. Since the closing of the books debentures of the par value of £3,361 have been purchased, making the total par value of debentures retired to date, £10,421.

The directors have followed their usual practice of making reserves to cover risks in connection with bad debts, depreciation of shares held by the company, and for other contingencies. The balance-sheet shows a profit of £10,932 as the result of the year's working after paying interest on debentures and on loans, which the directors recommend should be appropriated, as shown in the profit and loss account and balance-sheet, leaving a balance of £248, which, together with the previous year's balance, makes the total amount to be carried forward £2,599.

Madras Electric Tramways (1904), Ltd.—The directors have declared an interim dividend of 4½ per cent. per annum (2s. 3d. per share), less income-tax, on the preferred ordinary shares for the half-year.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.—The directors have declared a dividend on the preference shares at the rate of 6 per cent. per annum for the six months to September 30th.

Eastern Extension Telegraph Co., Ltd.—The directors have declared an interim dividend for the quarter to June 30th of 2s. 6d. per share.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight.	£*	No. of wks.	Total to date.	£*	Route miles open. Inc.
Aberdeen	Sept. 14	1,956	+ 72	15	23,488	— 178	.. ..
Ayr	„ 17	1,033	+ 31	18	7,851	+ 306	8 ..
Bath	„ 17	1,995	+ 233	37	30,723	+ 1,661	.. ..
Belfast	„ 16	8,267	+ 604	23	93,949	+ 4,465	37 ..
Birkenhead	„ 18	2,215	+ 79	24	27,384	+ 698	13·68 ..
Birmingham Corp.	„ 10	13,253	+ 505	23	156,360	+ 1,918	56·4 ..
Blackburn	„ 14	2,382	+ 50	24½	27,225	— 1,000	14·6 ·12
Blackpool Corp.	„ 15	4,910	+ 533	..	40,523	+ 2,216	.. ..
Blackpool-Fleetw'd	„ 17	3,031	+ 324	11	17,848	+ 644	.. ..
†Bolton	„ 18	2,340	— 25	25	59,262	+ 99	26 ..
Bournemouth	„ 14	4,379	+ 363	23½	48,833	+ 4,354	21·9 ..
Bradford	„ 10	10,406	+ 412	24	121,509	+ 4,033	54·8 ..
Brighton	„ 18	2,376	+ 94	24½	26,753	..	9·5 ..
Bristol	„ 16	12,681	+1,364	..	..	..	.. ..
Brit. Elec. Trac. Co.							
Airdrie	„ 9	475	+ 14	36	7,850	+ 39	3·65 ..
Barnsley	„ 9	334	— 15	36	6,239	+ 166	.. ..
Barrow	„ 9	624	+ 102	36	9,851	+ 1,448	5·37 ..
Cavehill	„ 9	237	+ 35	36	3,403	+ 169	.. ..
Devonport	„ 9	959	+ 186	36	15,356	+ 2,074	8·85 ..
Gateshead	„ 9	2,021	+ 39	36	35,543	— 157	11·25 ..
Gravesend	„ 9	448	— 39	36	7,551	— 39	6·5 ..
Greenock	„ 9	1,440	+ 158	36	22,927	+ 3,003	7·25 ..
Hartlepool	„ 9	615	+ 82	36	9,126	+ 612	6·72 ..
Kidderminster	„ 9	268	+ 8	36	4,120	+ 115	.. ..
‡Leamington	„ 9	356	— 59	36	6,101	— 268	.. ..
Merthyr	„ 9	447	+ 6	36	7,502	— 236	2·9 ..
Metropolitan	„ 9	16,471	+2,489	36	269,504	+46,438	22 ..
Middleton	„ 9	647	+ 52	36	11,549	— 734	8·5 ..
Mid. Joint Com'tee	„ 9	11,824	+ 170	36	208,112	+ 2,268	.. ..
Oldham—Ashton	„ 9	1,283	— 26	36	20,103	— 131	9·13 ..
Peterborough	„ 9	254	+ 2	36	4,201	— 70	5·31 ..
Potteries	„ 9	3,613	— 112	36	62,840	— 708	29 ..
Rothesay	„ 9	661	+ 9	36	8,780	+ 58	2·75 ..
Southport	„ 9	691	+ 6	36	10,918	+ 167	8·17 ..
S. Metropolitan	„ 9	1,717	— 72	36	30,066	+ 1,135	.. ..
Swansea	„ 9	2,349	+ 249	36	39,260	+ 4,450	12·5 ..
Tynemouth	„ 9	681	— 10	36	9,883	+ 482	3·75 ..
Weston-s-Mare	„ 9	659	+ 27	36	6,100	— 59	3 ..
‡Worcester	„ 9	655	+ 16	36	10,339	+ 188	5·75 ..
Wrexham	„ 9	201	— 22	36	3,509	— 43	.. ..
Yorks. Wool. Dist.	„ 9	2,013	+ 37	36	35,546	+ 2,830	17 ..
Miscellaneous	„ 9	487	+ 6	36	7,936	+ 329	.. ..
Burnley	„ 17	2,841	+ 137	..	..	..	.. ..
Burton-on-Trent	„ 18	536	+ 6	24	6,687	— 6	6·66 ..
Bury	„ 18	2,507	— 9	24½	29,373	— 413	22·5 ..
Cardiff	„ 10	4,851	+ 427	24	54,389	+ 410	.. ..
Carlisle	..	..	..	..	..	..	.. ..
Chatham and Dist.	„ 8	1,883	— 35	36	30,634	+ 1,016	14·98 ..
Cork	„ 15	1,127	+ 123	37	18,245	+ 1,749	9·89 ..
Croydon	„ 9	3,320	+ 3	..	38,422	+ 3,325	11·25 ..
Darlington	„ 17	414	+ 49	25	5,017	+ 342	.. ..
Darwen	„ 16	559	+ 21	24	6,089	— 104	4·36 ..
Dover	„ 10	560	+ 42	23	5,655	+ 145	4·75 ..
Dublin	„ 16	11,536	+ 852	..	68,106	+ 1,486	54·25 ..
Dundee	„ 14	2,468	+ 63	17½	21,552	+ 347	15·5 ..
East Ham	„ 17	2,110	+ 108	24½	25,639	+ 704	8.52 ..
Exeter	„ 16	718	+ 3	24	8,231	+ 686	5·5 ..
Glasgow	„ 17	37,898	+2,455	..	276,·37	+14,961	97·75 3·25
Hastings	„ 15	2,759	— 55	..	..	..	.. ..
Huddersfield	„ 17	3,488	+ 132	25	43,143	+ 2,156	27·5 1
Hull	„ 17	5,201	— 24	24	65,710	+ 3,415	14·5 ..
Ilkeston	„ 15	268	+ 3	24	3,153	— 187	.. ..
Ipswich	„ 17	936	+ 1	24	11,229	+ 593	10·5 ..
Kilmarnock	„ 17	312	+ 13	18	2,858	+ 83	4·25 ..
Lancashire United	„ 14	2,973	— 181	..	48,765	— 497	39 ..
Leeds	„ 10	14,217	+ 446	23	167,031	+ 5,296	.. ..
Leicester	..	..	..	..	..	..	.. ..
Leith	„ 17	1,239	+ 33	17½	11,679	+ 46	8·7 2
Liverpool	„ 10	22,509	+ 731	36½	401,976	+14,558	113·5 4
‡L.C.C.	„ 7	82,911	+7,834	..	963,010	+126,505	133 9
London United	„ 17	13,282	+ 168	..	238,688	+ 9,630	.. ..
Lowestoft	..	..	..	..	..	..	.. ..
Manchester	„ 17	31,610	+1,117	24	377,567	+ 730	183 1
Newcastle	„ 17	7,456	+ 42	..	96,721	+ 1,116	14·5 ..
Newport	„ 10	1,420	+ 137	24	16,745	+ 680	14·5 ..
Oldham	„ 18	3,668	+ 102	..	47,191	— 915	23·75 ..
Pontypridd	..	..	..	..	..	..	.. ..
Portsmouth	„ 10	5,148	+ 136	23	52,748	+ 1,568	15½ ..
Preston	„ 14	1,559	+ 45	24	17,950	— 296	.. ..
Rotherham	..	..	..	..	..	..	.. ..
Salford	„ 19	9,801	+ 375	24½	116,238	+ 1,733	.. ..
Sheffield	„ 20	11,921	+ 732	25½	151,158	+ 8,908	40 ·8
Southampton	„ 14	2,417	+ 116	24	27,388	+ 614	.. ..
Southend-on-Sea	„ 14	1,615	+ 260	24	16,676	+ 1,788	.. ..
South Shields	„ 17	1,147	+ 42	24½	14.211	+ 8	.. ..
Swindon	„ 7	316	+ 21	..	3,325	+ 152	.. ..
Tyneside	„ 14	864	+ 14	11	5,465	+ 349	.. ..
Wallasey	„ 10	2,086	+ 136	23½	23,189	+ 199	.. ..
Walthamstow	„ 17	1,488	+ 90	24	18,268	+ 1,126	9 ..
West Ham	„ 8	4,976	+ 265	28	57,610	+ 2,895	15·25 ·12
Wolverhampton	„ 14	1,846	+ 189	24	22,968	+ 3,194	14·25 1·75
Cen. London Rly.	„ 17	10,745	+ 788	11	57,605	+ 3,999	6·89 ..
City & S. Lon. Rly.	„ 18	6,256	+ 82	11	33,808	+ 226	7·26 ..
Dublin-Lucan Rly.	„ 16	337	+ 45	11	1,968	+ 115	¶ ..
G.N. and City Rly.	„ 17	2,686	+ 98	11	14,289	+ 497	3·5 ..
L'pool Overh'd Rly.	„ 18	2,893	+ 100	..	17,738	+ 158	6·8 4·8
Llandudno-Col. Bay	„ 16	1,966	+ 201	41½	12,698	+ 249	.. ..
London Elec. Ry. Co.	„ 17	23,350	+ 240	11	126,080	+ 635	21·25 ..
Mersey Railway	„ 17	3,991	+ 64	11	21,411	+ 318	4·5 ..
Metropolitan Rly.	„ 18	33,151	+ 923	..	181,159	+ 5,955	24·5 ..
Met. District Rly.	„ 17	20,288	+1,298	11	110,268	+ 6,891	24 ..
Anglo-Argentine	„ 16	99,378	+9,520	..	1,683,190	+190,802	.. ..
§Auckland	Aug.	15,413	+2,313	8½	80,673	+ 3,270	23·3 1
Bombay (B.E.T.)	Sept. 9	5,218	+ 33	33	88,821	+ 6,172	.. ..
§Brisbane	Aug.	21,950	— 47	22	144,795	+13,548	.. ..
§Brit. Columbia Rly.	..	..	..	..	..	..	.. ..
Calcutta	Sept. 17	7,370	+ 459	..	..	..	.. ..
§Cape Electric T. Ld.	..	..	..	..	..	..	.. ..
§Kalgoorlie, W.A.	Aug.	3,985	..	..	23,011	..	20 ..
Madras	Aug. 31	1,892	— 16	..	21,550	+ 1,219	.. ..
Montevideo	Aug.	29,256	+3,045	40	235,619	+22,746	.. ..
§Lisbon	..	..	..	..	..	..	.. ..
†Perth (W.A.)	July 15	1,529	+ 149	..	48,978	+ 3,871	29 1

* Compared with the corresponding period of 1909. † One week only.
‡ Includes horse, steam and other receipts. ¶ One month.

STOCKS AND SHARES.

Tuesday Evening.

THE pleasantest thing to write about this week, in the Stock Exchange electricity markets, is the boomlet in the Latin-American Tramway and Power section. Apart from this, the other departments exhibit considerable steadiness, but not much movement. The rises of the past fortnight in telegraph and telephone issues have been well maintained.

Home Rails are again under the cloud of labour troubles. The strike of the Cambrian colliers served to depress the whole market, and no section eluded its influence. As it was remarked last week, the result of these labour troubles is simply to turn capital more and more into foreign channels, and the investor in self-defence removes money from domestic securities in order to place it abroad, where there may certainly be the risk of volcanoes, earthquakes, revolutions and other landslides, but where the labourer is not quite so—highly-educated, let us say, as he is at home.

Electrical railway stocks have not fallen anything like as much, in proportion, as the steam stocks have. Central London Deferred is down a point, and the tone of the market is certainly dull, but the other nominal prices are left standing as they were.

Prices of the shares in the Metropolitan electricity supply companies are quietly firm. The inquiries of the capitalist are beginning to spread to this market as advances in County of London Preference and in Charing Cross Preference shares testify. These two undertakings, with the City of London, are seizing time by the forelock in the commencement of a campaign for advertising the merits of their wares just as the chill of autumn nips the morning and the evening air. It is, we trust, no breach of confidence to hint that Parliament may be applied to before long, with a view to the granting of powers for the furtherance of the companies' usefulness to the public. This, of course, is the season of the year when all "illumination" investments should be brightening up, and even though the electricity supply concerns may have to present one more set of reports more or less colourless, the next half-year ought to show how the long lane of depression is past the turning-point, and another era of prosperity is ahead.

Mexican Light and Power issues are active, but unchanged as regards prices except for the bonds, which gained ¾. Mexican Electric Light 5 per cent. bonds rose a similar fraction, and Electrical Development of Ontario Fives are 2½ up. Mexico Trams put on another ½ after their five points rise of last week. The Mexican companies are benefiting largely by the *fêtes* in connection with the centenary. Rio de Janeiro Trams have been a strong feature at 103½, showing a rise of 3¼. Sao Paulo went back a couple of points at 155. Perth Electric Trams Ordinary, at a sovereign, show a 5s. rise, and Para Electric Trams at 6⅛ are 2s. 6d. better.

British Columbia Electric Deferred eased off 3 and British Electric Traction Preference fell 5s. Calcutta Trams are better.

The Telegraph and Telephone market continues to go ahead, the investor putting a good deal of money into the leading shares. About the only things in the list to show a decline are the Anglo-American Telegraph stocks, which have moved in conjunction with the American Railroad market. Mackay Companies Common, however, have gone up 3, excluding the 1¼ per cent. deducted for dividend, while the Preferred, *ex* 1 per cent. dividend, exhibits no alteration. West India and Panama shares again advanced, emphasising the remark made here last week that there was then plenty of scope for a further rise. The First and Second Preferences are now on the same line at 9½, showing rises of 5s. each, the Ordinary being ⅛ up. The Eastern group is steady, without much change. Globe Telegraph Preference improved a small fraction.

Amongst the Telephone descriptions that have risen during the week are Chile, Oriental, and United River Plate Preference. The National Telephone group is marking time. Reuter's rose ¼ and Marconi's remain dullish.

Following the rise in Telegraphs, the industrial section is also firm. Callender's Debenture stock rose 1½, and all three Henley issues display improvements. Telegraph Constructions are good. British Insulated Ordinary at 7½, are now *ex* the dividend of 4s., the price being left unaltered. Dick, Kerr & Co. have declared a dividend at the rate of 5 per cent., as against 6 per cent., and the carry-forward of £42,258 is £20,000 less than a year ago. Rubber shares remain flat in consequence of the fall in the price of the raw material.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be quoted in the Official List: Winnipeg Electric Railway Co.—Further issue of £20,000 4½ per cent. perpetual consolidated debenture stock.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations Sep. 13th.	Closing Quotations Sep. 20th.	Business done week ended Sep. 20th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
		*										
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	3½— 4	3⅝— 4¼	..	..	+ ⅛	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	95 — 97	95 — 97	..	..	..	4 17 7
255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	138 —141	138 —141	..	..	..	5 13 6
53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
558,460	Anglo-American Telegraph	Stock	3⅞%	3¾%	£3 4s.	3⅜%	67½— 69½	67 — 69	68	..	— ½	5 5 1
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	110 —112	109 —111	111½	110	—1	5 7 2
3,220,770	Do. do. do. Deferred	Stock	1⅜%	1 %	8/-	25/-	27½—27⅞	26⅝— 27⅛	27⅛	26⅛	— ⅜	4 12 7
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	9⅜— 9⅝	9½— 10	9⅝	9⅜	+ ⅛	4 0 0
2,449,176	Commercial Cable, Sting. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	84½— 86½	85 — 87	86½	85⅞	+ ⅜	4 12 0
16,000	Cuba Telegraph	10	5 %	6 %	6 %	6 %	8⅝— 9⅜	8⅞— 9½	9⅛	8 13/16	+ ⅛	6 6 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16½— 17½	16¼— 17⅝	..	..	+ ⅛	5 14 3
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅝— 3¾	3⅝— 3¾	..	..	+ 1/16	5 3 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½— 8¾	8⅝— 8⅞	8¾	..	+ ⅛	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100½—102½	100½—102½	..	..	..	7 16 10
60,710	Direct United States Cable	20	4⅜%	4⅜%	4½%	4 %	16 — 16½	16 — 16½	16 1/16	16⅛	..	4 17 0
36,000	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99½—101½	100 —102	..	..	+ ½	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	133 —136	133 —136	134⅜	133	..	5 2 11
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	84 — 86	84 — 86	84½	84	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	102½—104½	102⅜— 104⅛	102⅝	..	..	3 16 7
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜— 13¼	12⅜— 13¼	12 1/16	12⅝	..	5 5 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	100¼	..	..	3 18 5
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5¼%	5¼%	5⅜%	5⅜%	10½— 11	10⅛— 11	10⅞	10⅜	..	5 6 6
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅜— 13⅝	13⅛— 13½	13 1/16	13 1/16	+ ⅛	4 7 3
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	20 %	18 %	..	30 — 31	30— 31½	..	..	+ ½	5 10 9
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	53 — 55	53 — 55	..	..	..	6 15 8
$41,380,400	Mackay Companies Common	$100	3½%	4 %	4 %	4½%	86 — 90	89 — 93 xd	..	..	..	4 11 5
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	74 — 78	74 — 78 xd	..	..	..	5 2 7
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	15/7½	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	6 %	3/32— 5/32	3/32— 5/32	..	..	..	6 4 8
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	3/32— 5/32	3/32— 5/32	18/6	..	..	5 3 11
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	104½—106	104½—106	105½	104½	..	5 13 2
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	123 —125	123 —125	125¾	123	..	4 16 0
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅜	10 — 10⅜	..	..	..	5 11 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	5 %	6 %	6 %	6 %	10 — 10⅜	10 — 10⅜	..	..	..	5 11 8
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	..	4 10 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	..	..	..	3 10 0
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	7 %	8 %	8 %	8 %	1⅛— 1⅜	1 1/16— 1 1/16	32/3	31/3	+ 1/16	4 14 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	86 — 88	86½— 88½	..	..	+ ½	4 10 5
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	97¼— 99½	98 —100	..	..	+ ½	4 0 0
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7⅜— 8⅛	7⅜— 8⅛	..	..	+ ⅛	4 17 7
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	98½—100½	99 —101	..	..	+ ½	4 9 1
3,042	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	132 —135	133—136	..	..	+1	4 8 3
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7⅛— 7⅜	7⅛— 7⅜	7 1/16	..	..	5 8 6
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5 1/16— 5 1/16	5 3/16	..	— 1/16	4 11 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1⅝— 1⅞	1 1/16— 1 1/16	..	..	..	4 10 2
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97½— 99½	98 —100	..	..	+ ½	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13⅜— 14½	13⅜— 14½	14 1/16	13 13/16	..	4 18 3
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100—102	100—102	..	..	..	3 18 5
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1⅝— 1 7/32	1⅛— 1½	25/-	22/6	+ 3/32	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	8 %	6 %	6 %	6 %	9 — 9½	9½— 9⅝	9⅝	9 7/16	+ ⅛	6 3 1
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	14½%	8⅞— 9⅜	9½— 9⅝	9⅝	9⅜	+ ⅛	15 0 0
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101½—103½	101½—103½	..	..	..	4 16 7

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	..	5 %	4½— 4¾	4½— 4¾	93/11½	91/3	..	5 5 3
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	..	5 %	4½— 4⅝	4½— 4⅝	..	..	..	5 11 1
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	91½— 93	92 — 93½	93	92½	+ ½	4 5 7
332,387	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —105	103 —105	..	..	..	4 15 3
930,000	Babcock & Wilcox, 1 to 930,000	1	20 %	20 %	20 %	24 %	5⅜— 5⅝	5⅜— 5⅝	5⅝	5½	..	4 6 6
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 3/16	1 1/16— 1 3/16	..	..	..	3 19 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	..	..	..	..	..	5 9 7
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	8 %	8 %	8 %	143 —147	140 —144	146	142	—3	5 11 1
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	124 —128	124 —128	124½	..	..	4 13 9
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	111 —114	110 —113	112¼	111½	—1	4 8 6
233,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
133,301	British Electric Traction	10	Nil	Nil	Nil	Nil	⅝— 1	⅝— 1	..	..	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1½%	Nil	2⅝— 3	2⅝— 2⅞	51/3	48/9	— ⅛	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	89 — 93	89 — 93	91½	..	..	5 7 6
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	70 — 75	70 — 75	..	..	..	6 0 0
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	7 — 7⅛	7 — 7⅛xd	..	..	..	6 13 4
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6 — 6¼	6 — 6¼	..	..	..	4 12 4
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
201,579‡	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	98 —101	99 —101	..	..	..	4 9 1
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	Nil	5/16— 9/16	5/16— 9/16	..	..	..	Nil
1,316,853	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	61 — 63	61 — 63	..	..	..	6 7 0
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	⅜— 11/16	⅜— 11/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	Nil	0 — ⅜	0 — ⅜	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref... ..	2	Nil	Nil	Nil	Nil	0 — ⅜	0 — ⅜	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	37 — 42	37 — 42	..	..	..	10 14 4
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	22 — 26	22 — 26	..	..	..	17 6 3
137,610	Calcutta Trams, 1 to 137,610	5	8 %	6 %	4½%	4½%	4⅜— 5	4⅜— 4⅞	97/6	..	— 1/16	4 12 4
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	5 %	4⅜— 5	4⅜— 5⅛	..	..	+ ⅛	4 16 5
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	10 %	9⅛— 9⅞	9⅛— 9⅞	..	..	..	5 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	4 5 9
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	101⅛—103⅛	103 —105	..	..	+1½	4 7 0
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	3/32— 1/8	3/32— 1/8	6/8	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	12½%	3 1/16— 3 3/16	3 1/16— 3 3/16	63/-	60/7½	+ ⅛	3 18 9
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	104 —107	104 —107	..	..	..	4 2 0
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	63 — 65	63 — 65	64½	63⅜	..	4 12 4
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	84 — 86	84 — 86	..	..	..	4 13 0
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	47 — 49	46 — 48	..	..	..	4 3 4
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1½%	1⅝%	27⅛— 28½	27⅞— 28½	27⅞	27½	..	6 2 10
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	Nil	¼— ½	¼— ½	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	83 — 86	83 — 86	..	..	..	5 17 8

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Sep. 13th.	Closing Quotations Sep. 20th.	Business done week ended Sep. 20th, 1910.		Rise + or Fall —	Present Yield per cent.
		*	1906.	1907.	1908.	1909.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	6 %	6 %	1 — 1⅛	1 — 1⅛	..	..	..	5 6 8
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	5 1 1
271,080	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	..	..	..	4 9 1
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12⅜ — 13⅜	12⅜ — 13⅜	..	..	..	4 7 3
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½ %	2½ %	Nil	Nil	⅞ — 1	⅞ — 1	..	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	4½ %	2½ %	Nil	Nil	1 — 1⅛	1 — 1⅛	21/3	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 68	63 — 68	..	..	..	5 17 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	79 — 82	79 — 82	..	..	..	6 1 11
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	9 6 8
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	7⅞ — 8	7⅞ — 8	..	..	..	6 5 0
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	82 — 86	82 — 86	..	..	..	4 13 10
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	½ %	Nil	Nil	¾ — 1	¾ — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅝	10½ — 10⅝	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103½	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12 — 12⅜	12½ — 12⅝	12⅜	..	+ ⅛	5 16 6
40,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	4⅞ — 5⅛	4½ — 5⅜	..	..	+ 1/16	4 6 9
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½ %	4½ %	4½ %	4½ %	106 —108	106½ —108½	..	..	+ ½	4 2 11
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	10 %	14½ — 15	14½ — 15	..	..	..	6 13 4
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	½ %	Nil	Nil	13/16 — 15/16	13/16 — 15/16	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5 — 5⅛	5⅛ — 5⅜	..	..	+ ⅛	8 13 11
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	3 %	Nil	..	1½ — 2⅛	1⅝ — 2⅛	..	..	..	Nil
399,980	Do. do. 50,008 to 100,000	10	3 %	3 %	Nil	..	1½ — 2⅛	1⅝ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3⅜ %	..	2 — 2⅛	2 — 2⅛	..	..	..	15 0 0
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	68½	..	..	5 12 8
5,782,068	Metropolitan Consolidated	100	1 %	½ %	½ %	1 %	37⅞ — 38¼	37⅞ — 38¼	38	37⅞	..	3 5 4
2,640,914	Do. Surplus Lands	100	2½ %	2½ %	2½ %	2½ %	65 — 67	65 —67	65½	65½	..	4 2 1
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	21⅛ — 21⅜	21⅛ — 21⅜	21⅛	21½	..	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	..	4½ %	5%	5/16 — 7/16	5/16 — 7/16	..	..	..	5 17 8
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	5/16 — 7/16	5/16 — 7/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	15/16 — 1⅛	15/16 — 1⅛	17/9	..	..	5 6 8
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½ %	4½ %	4½ %	4½ %	96 — 99	96 — 99	98	97½	..	4 10 11
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	6 %	127½ —129½	128½ —130½	129½	128⅝	½	4 11 11
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	..	5 %	5 %	97½ — 98½	97½ — 98½	98½	97⅛	..	5 1 6
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅜ — ⅝	⅜ — ⅝	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	82 — 85	82 — 85	82	..	..	5 3 6
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	15 %	17½ %	35 — 37	35½ — 37½	36½	35½	+ ½	5 12 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100¾ — 102½	101 —103	..	..	+ ½	3 17 8
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	..	5 %	..	103 —104	103 —104	..	..	..	4 16 2
2,800,000	Do. do. 4½ % Bonds	..	..	..	4½ %	4½ %	93 — 95	92 — 94	94½	92	..	4 14 9
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	38 — 40	38 — 40	..	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	10 %	5 %	Nil	1/16 — 3/16	1/16 — 3/16	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1½ — 1⅝	1½ — 1⅝	..	..	..	8 11 5
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	60 — 70	60 — 70	..	..	..	5 14 4

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	10 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 15 7
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6¾ — 7⅛	..	..	..	4 14 11
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	100 —103	..	..	+1	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3⅜ — 3⅞	3⅜ — 3⅞	..	..	..	6 9 0
80,000	Do. do. 4½ % Cum. Pref.	5	4½ %	4½ %	4½ %	4½ %	4⅛ — 4⅜	4⅛ — 4⅜	88/9	..	+ ⅛	4 14 9
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½ %	4½ %	4½ %	4½ %	3⅜ — 4⅛	3⅜ — 4⅛	77/6	..	..	4 17 0
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	97½	..	..	4 2 6
49,436	Chelsea Electricity Supply, Ord.	5	4½ %	4½ %	4½ %	4½ %	3⅞ — 4⅛	3¾ — 4 xd	72/6	..	..	5 12 6
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	4½ %	99 —101	99 —101	..	..	..	4 9 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	11⅛ — 11⅜	11⅛ — 11⅜	11⅜	11⅛	..	6 0 5
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅛ — 12⅛	11⅛ — 12⅛	11⅛	..	..	4 19 0
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	120 —124	120 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½ %	4½ %	4½ %	4½ %	99½ —102½	99½ —102½	..	..	..	4 7 10
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1½ — 2	1½ — 2	..	..	..	Nil
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅝ — 3⅛	2⅝ — 3⅛ xd	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94½ — 96½	94½ — 96½	..	..	..	5 3 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅜ — 7¾	7⅜ — 7¾	..	..	..	6 7 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11	10⅝ — 11⅛	..	..	+ ⅛	5 6 8
400,000	Do. do. 4½ % Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	104½ —107½	104½ —107½	..	..	..	4 3 9
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	100 —103	100 —103	101⅜	..	..	4 7 5
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	3 %	Nil	Nil	Nil	1⅝ — 2	1⅝ — 2	35/-	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	75 — 78	75 — 78	..	..	..	5 15 5
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	5 %	5 %	82½ — 85½	82½ — 85½	..	..	..	5 17 0
10,000	Folkestone, 1 to 10,000	5	5½ %	5½ %	5½ %	5½ %	4½ — 4⅝	4½ — 4⅝ xd	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	4⅞ — 5⅛ xd	..	..	..	4 11 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..	4 8 3
15,000	Hove, 1 to 15,000	5	9 %	8½ %	8½ %	8½ %	7 — 7⅛	7 — 7⅛	..	..	..	5 13 4
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	100½ —102½	100½ —102½	..	..	..	4 17 7
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
90,000	Do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
11,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	2½ %	3 %	..	1⅝ — 2	1⅝ — 2	..	..	..	4 8 11
70,000	Do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅛ — 5⅛	4⅛ — 5⅛	5 1/16	..	..	5 15 8
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	90 — 92	90 — 92	..	..	..	4 7 7
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½ %	5 %	5 %	3¼ — 3⅜	3¼ — 3⅜	68/9	..	..	7 8 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½ %	4½ %	4½ %	4½ %	4 — 4¼	4 — 4¼	..	..	..	5 0 0
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½ %	4½ %	4½ %	4½ %	102 —105	102 —105	..	..	..	4 5 9
248,000	Do. 3¾ % Mort. Deben. Stock Redem.	Stock	3¾ %	3¾ %	3¾ %	3¾ %	82 — 85	82 — 85	90½	..	..	4 2 4
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	89 — 90	89⅜ — 90⅜	90¼	90	+ ⅛	5 10 2
13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	4 %	3½ %	4 %	87½ — 89½	87½ — 89½	89½	88⅛	..	4 9 5
£2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	108 —110	108 —110	109	108⅜	..	6 7 3
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	94⅛ — 95⅞	95 — 96	96	94½	+ ⅛	5 4 2
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½ %	4½ %	4½ %	4½ %	95⅛ — 97½	95⅜ — 97½	..	..	..	4 12 4
130,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½ %	..	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	2 17 8
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	..	5 %	100 —102	100 —102	..	..	..	4 18 0
10,862	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	12 — 13	12 — 13	..	..	..	5 7 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	6⅝ — 6⅞	6½ — 6⅝ xd	..	..	..	5 3 8
119,694	River Plate Elcty. Co. Ord.	Stock	2½ %	6 %	8 %	9 %	210—225	210—225	217	215	..	4 0 4
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	6 %	105—115	105—115	..	..	..	5 4 4
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	100¾ —102½	100¾ —102½	..	..	..	4 17 7
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	7⅜ — 8¼	7⅜ — 8¼	..	..	..	6 1 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6¾ — 7¼	6¾ — 7¼	..	..	..	4 16 7
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½ %	3 %	3½ %	3½ %	84 — 86	84 — 86	..	..	..	4 1 5
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1½ — 2	1½ — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	3 %	4 %	5 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 13 4
130,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½ %	2½ %	2½ %	..	1/16 — 3/16	1/16 — 3/16	..	..	..	6 13 4
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1/32 — 1/32	1/32 — 1/32	..	..	..	6 16 7
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	..	..	..	4 9 1
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	¾ — 1	¾ — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	2 — 2½	2 — 2½	43/9	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½ %	4½ %	4½ %	4½ %	79 — 81	79 — 81	..	..	..	5 11 1
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	..	⅜ — ⅝	⅝ — ⅞	16/3	..	— 1/16	6 3 1
100,000	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	8 — 8½	8 — 8½	8	..	..	5 11 1
51,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½ %	4½ %	4½ %	4½ %	5 — 5⅛	5 — 5⅛	5⅛	5	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 3 per cent. June 9th, 1910.

SOME NOTES ON THE PUMPING OF SEWAGE.

[COMMUNICATED.]

The practice of instructing the borough electrical engineer to prepare specifications for, and to buy, sewage pumping machinery for the borough surveyor's works, is very prevalent, and will increase in popularity as the advantages of electric driving become better known and appreciated. The following notes, based on personal experience in this connection, will therefore, it is hoped, be of service to many readers. There are many special points to be observed in the design of machinery for the pumping of sewage as distinct from other liquids, and in accordance with the trend of modern practice it is proposed to deal solely in this article with installations employing centrifugal pumps.

The author invariably regards sewage as having a specific gravity of 1·1; in regard to fluidity, the friction in pipes when conveying sewage is calculated from the well-known tables of Box as for ordinary water, and the values thus found are increased by 25 per cent. A margin of at least 5 per cent. for contingencies is allowed over the total calculated head, including friction, and provision is made for 10 per cent. reserve on the revolutions per minute and the B.H.P. required to drive a pump in order thoroughly to cover the loss due to viscosity of the liquor in the pump itself. It may be mentioned here that reinforced concrete piping is now being used for sewage disposal works, and offers as smooth a path for the flow of the liquid as clean varnished cast-iron pipes. The liquor must pass through a screen on its way to the sump, and the engineer should arrange the mesh of his straining arrangement after he has obtained from the makers dimensions of the largest solids which the impellers of the proposed pumps will pass. Hurdle screens may be used, but sheets perforated with holes of the requisite size are preferable. It is most important when dealing with sewage for the pump sumps to be of ample dimensions, plenty of room being allowed round the entrance to each suction pipe, thus avoiding losses due to head at entry; and where several pumps are installed sucking from a common trench, the suction pipes should be placed so far apart that eddies do not result, and consequently each pump may draw the volume for which it is designed. The floor of the suction chamber must slope down towards the sludge well at one end, while the pump nearest this well is arranged with its suction inlet below a step in the floor, so that the sump may be periodically emptied for access to the foot-valves. For sewage disposal, pumps should be given large diameter branches designed to pass the full flow of liquor with low velocities in all the passages, while adequate mud-holes must be provided for facility of access for cleaning.

It is thought by some that when dealing with liquid of this character it is necessary to use gun-metal impellers and diffusion vanes, but this is by no means the case; cast-iron treated with special non-corrosive paint is amply suitable for the purpose. It is absolutely requisite to provide a clean supply of sealing water for the glands of the pump; town's water supply may be used if available, or a tank installed so that the sealing water is fed into the gland packings under a head of from 30 to 35 ft. Oil lubricators may be used in connection with the glands, but they do not give the reliability afforded by a water seal in keeping air from the eye of the pump. Where the spindle of the machine passes through the glands it should be fitted with renewable sleeves. There is an increasing tendency nowadays to use vertical spindle pumps and motors, placing the latter with their control gear on a separate floor above the pump chamber. In this case suitable removable floor plates must be laid down to allow the overhead traveller in the motor room to dismantle all the machinery and raise both pumps and suction pipes for inspection or repairs. Automatic starting gear, controlled by floats in the sump, may be arranged so that pumping units may be put into action, quite independently of an attendant, on the occurrence of a storm. The floats and connecting cords of stranded wire must be of copper. The engineer must satisfy himself that vertical shafts of adequate dimensions and a sufficiency of steady bearings, never more than 5 ft. apart, are installed to prevent "whipping." Adequate ball thrusts must be provided to take the weight of the rotating parts. No bearings must come in contact with the sewage. With regard to accessories, each pump should be fitted with an amply large foot valve and strainer, the straining mesh being designed with knowledge of the dimensions of the impeller orifices, together with sluice valve and retaining valve. The foot valves and retaining valves must have hand holes for inspection and cleaning, while a lever arrangement actuated from the floor of the pump chamber may be arranged to hold up the foot-valve occasionally, so that it may be flushed through, the sewage simply running back into the sump. It is best not to employ all cast-iron sluice valves, such as are sometimes used in sewage work, on account of cost; those with gun-metal disks and seats are much more reliable and easy to work with, as it is hardly possible for them to stick. The pumps in an electrically driven plant are usually primed from the rising main; for the first start-up a pump can be filled from the clean water supply for sealing the glands. Pressure and vacuum gauges may be used to measure the discharge and suction heads respectively, and to find the total head the height between their respective inlets must, of course, be added on. The best method of measuring the discharge of sewage consists in putting a Venturi meter in the common rising main as it leaves the pumping station, the meter having connection with an automatic recorder installed alongside the electrical switchboard.

SOME CABLE REPAIRS.

[COMMUNICATED.]

The experiences of a man in charge of electrical machinery usually include some very lively times due to the breakdown of cables if these are underground and if the system is at all extensive. Some of these are due to bad work; others, however, are more likely to be caused by matters which are to some extent unforeseen, or which may be out of the control of the engineer. It may be interesting, therefore, to record one or two experiences which have occurred in connection with such cable systems in order that other engineers faced with similar problems may have some idea as to how to proceed.

One of the most potent causes of trouble in such systems is the misapplied energy of the unskilled labourer. It is no uncommon thing for an energetic navvy engaged in road repair or trench-making to drive his pick through the cable. In one such instance a pick was thrust right through a lead-covered distributor, piercing both the lead and the paper, and nearly severing the core. It was impossible at the time to relay this section of cable, as this would have involved a prolonged shut-down to an important consumer. The only course which appeared possible at the time was to strengthen the core at the fault by weaving in and sweating other strands of copper wire, and after this joint had been made, insulation was restored by means of taping. The lead covering was plumbed over and the plumbing was painted over with ordinary box compound. It was recognised, however, that to lay the lead-covered distributing cable of this sort in a trench without any further protection, was a somewhat risky proceeding, and in all subsequent sections of cable-laying, the practice was followed of running out the cables into the trench, and, before completely filling in the trench, covering the cable with about 6 in. to 1 ft. of earth. This was beaten down so as to form a hard solid covering, and then cheap tiles or bricks were laid breadth to breadth on the top of the beaten earth along the length of cable. These bricks were then sufficient to give warning to anyone who was digging or using a pickaxe that a cable was near, and, therefore, the pick was prevented from reaching the cable.

In another case a vulcanised bitumen cable-network was laid out on the system of placing the cable in bitumen, which was carried in a wooden trough, the cable being kept from the bottom of the trough by means of wooden bridges. Unfortunately, however, at a particular point the combination of two circumstances led to the leaking-in of water.

One of these circumstances was that there was a bad joint in the trough, and the second was that at that particular point the cable was resting on a wooden bridge, and there was, therefore, no bitumen covering the cable underneath. The water acting on the vulcanised bitumen insulation gradually rotted it, and finally caused an earth fault. In order to get rid temporarily of this trouble the fault was localised and the bitumen knocked away. A fresh piece of troughing was then laid in and the cable at the point of the fault was temporarily jointed by means of taping up and using a long sleeve, soft bitumen being then run round it. When, however, a convenient occasion arose, a further piece of cable was laid in, and extra care was taken to see that the cable was completely surrounded with bitumen. This, however, is a fault which is extremely likely to occur on a solid laid system.

A rather expensive case of trouble, which occurred on a lead-covered cable feeding street arc lamp circuits, arose through a faulty drawing-in of the cable into cast-iron pipes. The ends of these pipes had been left rough, and the lead of the cable had been cut and scored owing to its fouling the pipes at the edge. After a short time water was absorbed by the paper, and the result was that a bad earth fault was developed. In this case nothing could be done with the trouble, inasmuch as the water percolated along a considerable distance of the cable rendering it entirely useless. The only thing that was possible was to cut off the current from the cable at each end, that is to say, at the fuse-box from which it took its supply and at the end lamp. At a convenient time, however, the cable was drawn out and replaced, and three things were observed. First, the iron pipes were furnished with bell mouths at the point where they entered the box through which the cable was drawn, so as to avoid the risk of abrasion due to sharp edges. Secondly, a plentiful supply of soft soap was used as a lubricant on the cable while it was passing through the pipe, in order to reduce friction, and, therefore, strain, as much as possible; and lastly, greater personal supervision on the part of the engineer was observed during the process of drawing in the cables by the labourers.

A rather interesting accident occurred in connection with an arc lamp circuit which was run across the outers of a three-wire system. The cable was lead-covered arc cable laid solid in a trough filled with bitumen, and it was carried in each case to within a foot or two of the arc lamp-post. At this point rubber cables were jointed on the lead-covered cable and run in a galvanised iron pipe up to the base of the post to the terminals. Unfortunately, however, water got into one of these pipes at the ground end, and remaining in the bend, deteriorated the cables and caused an earth fault. As the point where the earth occurred was between the fourth and fifth lamps of an eight-lamp circuit which was burning on a fairly well balanced three-wire network, the lamps on the circuit still burned, although in a somewhat unsteady manner. It was not, therefore, necessary immediately to shut down the lighting. After drying out and overhauling the cable, attempts were made to fill the galvanised pipe with compound, but it was impossible to do this, as the bitumen cooled too rapidly and blocked the pipe at the entrance. It was therefore necessary to design special joint-boxes which received the troughing at one end and the piping at the other, thus making a sound water-tight joint between the paper-covered cable and the rubber-covered leads to the arc lamps. This arrangement was found to prevent all further trouble.

The above instances will, of course, be recognised as perfectly ordinary occurrences in connection with mains works, but they may be interesting from the point of view of being representative of the classes of cable breakdowns which may occur, and for this reason they have been submitted.

Olympia Exhibition.—We are informed that the Engineering Exhibition at Olympia, London, has proved a success from all points of view. The spectacular exhibits have appealed to the general public, who have taken great interest, not only in the demonstrations of diving and mine rescue work, but also in the cutting and welding by the oxy-acetylene process which is shown in actual operation on three stands. It has been decided to run a similar exhibition at Olympia in 1913, under the same patronage and management.

THE PRICE OF ELECTRICITY.

By George Offor.

I thoroughly endorse the paragraph in Mr. Edward W. Cowan's letter of 10th inst., in which he says: "Is there not considerable confusion of thought in the idea that early consumers, who paid relatively high prices, bore 'the heat and burden of the day.' 'Heat and burden' implies suffering, but I suspect that they obtained satisfaction, or they would not have paid the price."

As one of the earliest pioneers of the electric lighting industry, I have always been able to prove from the testimony of consumers that, apart from all the indirect economies and convenience, the electric light from the first supply was, light for light, cheaper than gas or other illuminants.

I go back to the interesting experience of the house-to-house supply at Colchester, which was the only town where the electric light was supplied under the Electric Lighting Act of 1882. The lamps were of the old carbon-filament type, costing about 4s. each, and, relatively to our present types, very inefficient. The price charged for current in the absence of meters certified by the Board of Trade, was at first ½d. per hour for 8-c.p. lamps, and, subsequently, 8d. per unit.

In spite of these conditions, I obtained numerous testimonials from consumers expressing satisfaction with the supply—this was in 1884—and when five years later the same system was carried out by the Chelsea Electricity Supply Co., Ltd., at a charge to consumers of 8d. per unit, I published some 30 testimonials expressing satisfaction, one of them stating that the "charges seem moderate, and compare favourably with the charges for gas."

In 1894, as managing director of the Crystal Palace District Electric Supply Co., Ltd., which supplied the current at a flat rate of 8d. per unit from a generating station at Sydenham, to a wide district including parts of Sydenham and Forest Hill, Beckenham, Upper Norwood, Lambeth, Camberwell, Croydon and the Crystal Palace. I was again furnished with numerous testimonials from consumers, some of which compared the relative prices of electricity and gas, testifying to the saving in cost, light for light, of electricity at 8d. per unit, against gas at 2s. 10d. per 1,000 ft. One of these testimonials was from a large grocery and drug stores at Sydenham, which I may reprint here as a specimen, the premises being now brilliantly lighted with metallic-filament lamps, at a cost which, in comparison with gas, is as "a China Orange to Lombard Street."

The testimonial referred to was to the following effect:—

1,028 *Candle-Power of Incandescent Lamps.*

Dear Sir,—Your company having supplied us for nearly 12 months past with electricity, it may interest you to know our experience of same.

We must first congratulate you upon your success in providing a continuous supply day and night, without a moment's cessation or mishap of any kind. This has given us every confidence, so much so that we have removed all our gas fittings. We are pleased to bear testimony to the beauty and superiority of the electric light, as compared with gas; and having practically tested the cost of both lights, we have come to the conclusion that, using equal candle-power, the electric light has the advantage, for although the electric supply has cost us half as much again as gas would have done, for same period, we have enjoyed nearly twice the light power, besides the advantages of a purer atmosphere, less risk of fire, and considerable saving in cost of broken gas shades, &c.

The electric light is undoubtedly the "up-to-date" light, and the sooner it is adopted in every household and place of business, the better it will be for the health, comfort and pockets of the present generation.

We are, dear Sir, yours faithfully,

(Signed) Sydney Smith & Sons, Ltd.

Sydenham, *January 15th*, 1894.

When the incandescent gas mantle was introduced, it was proclaimed as a formidable competitor with the electric light, but it did not prove to be the case, and in 1902 I published testimonials like the following:—

Hertford, *August 8th*, 1902.

Dear Sir,—We have made use of electric energy for lighting our place from the earliest moment possible.

The installation replaced gas with incandescent burners, and was also used in places where gas had been found unsuitable, and our

experience shows that 20 per cent. more light can be obtained for the same money, using electric energy in place of gas.

We are quite satisfied with the light, and hope the present satisfactory conditions will be maintained.

Yours faithfully,

(Signed) Geo. Durrant & Son.

The installation referred to was with carbon lamps, but with the metallic filaments the economy would, of course, be considerably greater.

In dealing with the question of the relative cost of electricity and gas, the indirect economies obtained by the former must not be overlooked, as they are of the very essence of the matter, and should be exhaustively dealt with in the publications issued by the electric lighting companies.

I published in 1894 an important letter on this question from Mr. John S. Sellon, whose mansion was, I believe, the first house supplied throughout by electricity. He installed the light from a private plant in 1881, and in his letter he thus dealt with the comparative cost of electricity and gas :—

In the matter of comparative cost with gas, I am under some difficulty in giving precise figures. Prior to my installing the electric light early in 1881, since which time it has worked continuously, I used candles and lamps to a very large extent in preference to gas, not permitting the latter in the principal reception rooms, the nurseries, or the bedrooms, except to a very limited extent.

But I have ample and conclusive evidence of a very large economy under certain heads of expenditure over the whole period since 1881 (even with the obvious disadvantage as to cost of running my own single installation). My personal experience, indeed, leads me to wander on this point beyond the lines ordinarily arrived at by electric light enthusiasts. In a question of such great importance, I consider that every detail should be carefully and conscientiously considered, and that a value (which in the case of diminished doctor's bills, and facilitated brain work, may prove a material one) should be set upon such factors as improved eyesight, comparative immunity from headache and lassitude, increased aptitude for work and for enjoyment, better sleep, and a general improvement in the health and spirits of a household, some or all of which most surely accompany the introduction of this light. Next to these matters comes the saving from deterioration of valuable pictures, books and curtain fabrics, and the very considerable economy year by year of expenditure in house-cleaning, whitewashing and decoration.

Startling as my views may at first appear, I have arrived at the definite conclusion that in dwelling houses of the upper and middle classes, except in cases where an extravagant and needless degree of illumination is indulged in, or due care not exercised in turning out the light when not required, the consumer having once paid for his fittings, and excluding the periodical cost of lamp renewals, now reduced to a bagatelle, may practically write off the amount he pays in pounds sterling for his electric current bill, as against absolute and valuable economies so brought about, and that he may safely revel in the feeling that he obtains his illumination practically at not much greater cost than that of the light of the sun, to which in health and effect it most nearly approaches.

I venture to express a hope that your energy and perseverance in this good cause may be rewarded by the almost universal adoption of the light in this district, and am,

Yours faithfully,

(Signed) John S. Sellon.

In a letter I received in 1902, from the firm of Messrs. Norman & Son, of Weston-super-Mare, an item of economy is mentioned which is worth quoting in connection with the question of cost ; they write as follows :—

By the use of electric light the danger of fire is reduced to a minimum ; so much is this recognised that our insurance company have reduced their fire premium by 10 per cent. per annum, the following clause being inserted in the policy, viz. :—

In consideration of the premises insured by this policy being lighted by the electric light, a discount of 10 per cent. is allowed off the premium of this policy.

Votes in a Good Cause.—We have learnt with regret that the late Mr. C. J. Robertson, the founder of the Robertson Electric Lamp Works, and a pioneer whose name is familiar to all electrical men, has left his family ill-provided for ; as he was a Freemason, his daughter has obtained a nomination as one of the candidates for the forthcoming election for the Royal Masonic Institution for Girls, and we heartily commend her candidature to all our readers who, as members of the Craft, or external subscribers, possess votes for this Institution. We shall be pleased to receive all such votes and forward them to the proper quarter.

POWER ECONOMY IN ELECTRIC RAILWAY OPERATION.*

By H. ST. CLAIR PUTNAM.

It is proposed in this paper to describe some tests made on the Manhattan elevated division of the Interborough Rapid Transit Co., New York, in which a clock was used to record the amount of coasting employed in the operation of trains, the object of this device being to obtain from the motormen a better manipulation of the trains, with the resulting economy in the use of power.

The clock consists of a mechanism of the type manufactured for recording the time of employés. To the balance-wheel escapement a braking device has been added, as shown in fig. 1, which is lifted

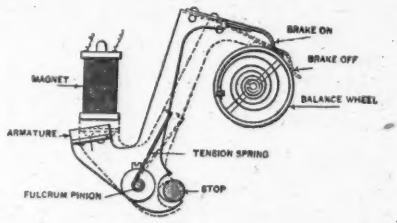


Fig. 1.

free from the balance wheel by an electromagnet which is energised only during the coasting of the train. Each motorman has an individual key, which he inserts on taking charge of the train and again on leaving. The turning of this key records his number or initials and the time as shown by the clock mechanism ; the difference in the time between the two records made by the key represents the total time of coasting during his run. The slip record is torn off by the motorman and turned in to the proper official. This is checked up with his running time, and the motorman is rated according to the percentage that the coasting time is of the total time of his run, allowance being made for schedule variation.

The electric circuits controlling the clock are interlocked with the master controller and the brake mechanism, and arranged so that the coasting clock will start only after the two actions of turning the power on and then off. The connections used are shown in fig. 2. The clock is stopped as soon as the air brakes are

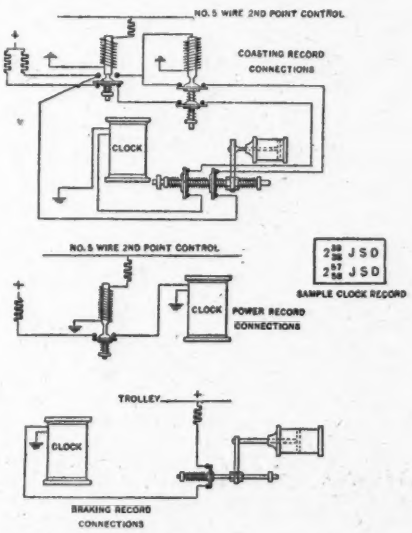


Fig. 2.

operated and the brake cylinder has started to move to the braking position. If, for any reason, after the brakes are applied, the air is released and additional coasting obtained before the train stops, this additional coasting is lost from the amount of coasting recorded unless power is again applied. This is not an important factor in normal operation, as the actual amount of coasting of this character is small.

The rapid acceleration of trains, providing the schedule speed is unchanged, results in an important saving of power for two reasons, first, the maximum speed reached is less with a high acceleration, and consequently the train resistance is somewhat less ; second, and of much greater importance, is the fact that with a high rate of acceleration, the speed at the start of braking is less than with a

* Abstract of a paper presented at the Twenty-seventh Annual Convention of the American Institute of Electrical Engineers Jefferson, N.H., June 28th-July 1st, 1910.

lower rate and, consequently, the energy absorbed and lost in braking is less. A quick acceleration is one of the most feasible methods of saving power in such a service as exists on the Manhattan railway. In the tests on the entire Manhattan system conducted on March 22nd, 1910, the acceleration of different motormen was found to vary from 0·9 m.p.h.p.s. to 1·47 m.p.h.p.s. Providing other factors of train operation remain the same (that is, the braking, running time and time of stop) the increase in the rate of acceleration from 0·9 to 1·47 m.p.h.p.s. will result in an increase in the percentage of coasting time from 0 to 40·5 per cent. of the total time, and a saving of 36 per cent. in energy consumption. A motorman on the Manhattan system on full runs will average about 600 car-miles a day, and the power used at the car with 0·9 acceleration will approximate 2·82 KW.-hours per car-mile. As between these two motormen, therefore, providing the scheduled speed is maintained, the motorman who accelerates his train at an average rate of 0·9 m.p.h.p.s. will waste during the day 610 KW.-hours at the car. With 80 per cent. efficiency to the power house, this becomes 762 KW.-hours.

It was found that an increase in the percentage of coasting obtained by reducing the amount of series running does not effect a corresponding saving in power. This is due to the fact that while the total time during which power is applied is increased and the time of coasting reduced by holding the controller in the full series position—say, for four or five seconds—the actual power used remains practically the same, because the additional power required on account of the longer time of power application is offset in large measure, if not entirely, by the saving in rheostat losses owing to the reduced time that the rheostat is in circuit in passing to full multiple. A limited amount of series running, therefore, is not objectionable, and under certain conditions it is better to run in series for a short time than to pass to the multiple position, especially where power is cut off almost immediately after the multiple position is reached, as under certain conditions in approaching a station. The decrease in coasting time resulting from a moderate amount of series running does not, therefore, necessarily represent an increase in power consumption, unless the series running has been excessive. In this respect the coasting clock will give misleading results; but as under normal conditions there is little occasion for running in series, excepting around curves, the error thus introduced into the record is not important.

A high rate of braking permits the power to be cut off at an earlier point, a longer time of coasting introduced, power otherwise wasted in the brakes to be recovered, and the train brought to a quick stop. Perfection in braking is much more difficult of attainment than acceleration, as the train must be stopped at the station within a space limited to a few feet. Many motormen feel their way into stations, with a material increase in the power used if schedules are maintained. Carefully conducted tests have shown 2 m.p.h.p.s. to be entirely practical. An increase in the rate of braking between the limits of 1 m.p.h.p.s. and 2 m.p.h.p.s. results in increasing the coasting to 48·5 per cent. of the total time with a saving in power of 35·5 per cent.

In the test made over the Manhattan system on March 22nd, the trains were not equipped for getting the braking rate. The average time required by the motorman in bringing the train to a stop varied from 10·2 seconds to 20·2 seconds. This would indicate approximate braking rates of 1·15 and 1·90 m.p.h.p.s. The higher rate would increase the coasting time from 26 per cent. for the lower rate to 47·5 per cent., and result in saving approximately 280 KW.-hours per day.

On the Second Avenue line the average run is 0·335 mile and the maximum possible stop with the maintenance of the schedule, and with no coasting, is 16·2 seconds, assuming an average run as typical. A reduction in the time of stop to 10 seconds results in an increase in coasting time to 45 per cent. of the total time and a reduction of 40 per cent. in the power used.

The amount of coasting which a motorman can obtain and still maintain his schedule, is obviously the result of the factors of operation. It will be noted that it makes but little difference which factor is altered. The percentage of power saved is substantially the same, however the increased coasting is obtained. This, of course, is to be expected. It is well to point out the very large saving in power consumption which results in reducing the stop from, say, 15 seconds to 10 seconds, assuming that the schedule speed remains the same. This saves 25 per cent. in power through increased coasting.

After all the trains on the Second Avenue line were equipped with clocks several tests were made, due allowance being made for heaters, lighting, wattmeter calibration, &c. The results obtained were necessarily approximate, but were remarkably consistent, and showed a material improvement in coasting and also a reduction in the power required for the car operation—namely, an increase in the time of coasting from 10 per cent. as it was prior to the installation of the clocks to 38 per cent. following such installation, resulted in a saving of 25 per cent. in the power required for traction.

To determine the fair average conditions as to coasting existing on all divisions of the system, tests were made on the Second and Third Avenue lines last fall, and two trains equipped with clocks were put in regular service this spring on the Sixth and Ninth Avenue lines.

The average of these results should be fairly representative of the coasting conditions at present, as well as prior to the installation of the coasting clock on the Second Avenue line. The men soon become aware of the trains equipped with clocks, however, and consequently are more careful in the operation than usual. It is probable, therefore, that the coasting data obtained from these tests are above rather than under the average conditions. A summary of the coasting data for all lines follows:—

Summary—Coasting Data.

	Car-miles per day.	Per cent. coasting.
Second Avenue	28,863	10·0
Third ,, ...	79,403	10·2
Sixth ,, ...	46,571	11·9
Ninth ,, ...	33,826	19·1
Average	188,663 (total)	12·2

In the table below is given the average coasting obtained during five weeks on the Second Avenue line, where the coasting clock has been in service for slightly over three months. The average run on this part of the Second Avenue line, as already pointed out, closely approximates the average run for the entire Manhattan system.

Second Avenue Line—Coasting Data. Coasting Clock Installed for Three Months.

	Average running time.	Average coasting time.	Per cent. coasting.
Week ending March 5th ...	28·7	10·5	36·8
,, ,, ,, 12th ...	28·7	11·1	38·8
,, ,, ,, 19th ...	28·5	10·8	37·7
,, ,, ,, 26th ...	28 5	10·6	37·0
,, ,, April 2nd ...	28·4	10·1	35·4
Average	28·6	10·6	37·1

The result of these calculations and tests shows that an increase in the percentage of coasting from 12 per cent. to 37·5 per cent., as shown above, will effect a saving of 24 per cent. in the power required for traction.

Coasting is the recovery of power already used, and, hence, is the key to the problem. The coasting clock, therefore, gives a direct measure of the power recovered by the motormen, and as this recovery can also only be made by cutting off the power application sooner, it is believed that it is the most effective element in train operation to measure. At the same time it concentrates the motorman's attention on that operating element which is the direct reason for saving power.

Combination of the Supply of Gas and Electricity.

—The Rhenish-Westphalian Electricity Works Co., of Essen, which originally sought to obtain a monopoly in this large industrial district of Western Germany, represents an undertaking which not only seeks increased prosperity as in the case of any other private enterprise, but also regards as immaterial the particular commercial means whereby this object is to be achieved. Electricity, gas, water and tramways come directly or indirectly within the scope of the company, whilst, on the other hand, the local authorities over an extensive area have the privilege, which has been exercised in many cases, of becoming large shareholders in the undertaking, although they usually have to pay a high premium for this purpose. According to the company's report for 1909-10, the sale of energy from the Essen station increased from 56,000,000 KW.-hours in 1908-9 to 69,000,000 KW.-hours last year, and the receipts rose by 21½ per cent. The temporary diminution in the sale for lighting due to the introduction of metallic-filament lamps, and the 8 o'clock shop closing, and to the restrictions caused to many businesses by the economic depression, has been overcome, and considerable applications for new connections have been made in the new financial year. In addition to the conclusion of a number of contracts with large new consumers, negotiations were completed during the year with the five Lower Rhenish districts of Moers, Kempen, Geldern, Cleve and Rees, and these assure to the company the right of supply for 30 years to almost the whole of the Lower Rhenish-Westphalian region. The capital required for the provision of the installations in these districts will be placed at the disposal of the districts by interested parties on suitable terms. On the other hand, the districts have resolved to participate in the company by the acquisition of shares, and the districts of Mettmann, Cologne-Land and Rheinbach have each decided to subscribe for £25,000 in shares. It is proposed to increase the share capital of the company for extensions by £400,000, which is to be offered to the district authorities at a price of 150 per cent. The gross surplus in 1909-10 amounts to £187,100, as compared with £183,000 in 1908-9, and after appropriating £48,000 for depreciation, as against £42,900, it is intended to pay a dividend of 8 per cent., being the same rate as in the previous year. The balance-sheet shows the Essen central station valued at £1,249,000, and other stations or works owned elsewhere at £431,000; investments in stations, tramways, and gas works—the Rotthausen gas works were acquired during the year—are entered at £1,243,000; loans or advances to other undertakings reach £781,000; whilst the company's share capital is £1,500,000, and the loan debt also £1,500,000.

Crusade against Consumption.—The National Association for the Prevention of Consumption, with the generous aid of the Billposters' Associations, is about to inaugurate a poster campaign for which 30,000 huge posters are being prepared, both to educate the public and to appeal for funds to carry on the work. Our readers' sympathetic interest and practical aid are solicited on behalf of this meritorious scheme.

THE BRITISH ASSOCIATION MEETING AT SHEFFIELD.

Utilisation of Solar Radiation, Wind Power and other Intermittent Natural Sources of Energy.

By Prof. R. A. Fessenden.

Prof. Fessenden's paper on the above subject was read before the Engineering Section of the British Association on Wednesday, September 7th. It evoked an interesting discussion. Prof. Fessenden explained that the use of these intermittent natural sources of energy involved a double problem. The energy must be so changed as to be available in form, and also to be available in time. He had been working at the problem since 1899, but only during the past year had he had time to draw up plans on a commercial scale for a 3,000-H.P. installation. He believed that the following figures were substantially correct, subject to modifications required to meet local conditions. Dealing first with the problem of storage, Prof. Fessenden explained that a storage battery was too expensive. A lead-oxide storage battery cost approximately £10 per H.P.-hour.* Measurements made during the past 10 years showed that it was necessary to provide storage capacity for at least two weeks, except under abnormally favourable conditions. The capital cost per horse-power for a storage battery would therefore be £140. Taking the interest at 4 per cent., depreciation at 10 per cent., and the upkeep and labour at 5 per cent., the annual cost of storing power with a storage battery would be approximately £26 per annum per H.P. Doubtless some storage battery companies would claim that these figures were too high, but they were believed to be substantially correct. As, however, 1 H.P. could be produced by a steam plant for not more than £10 per annum, it was evident that storage by storage batteries was entirely uncommercial for this purpose.

The method of storage adopted by the author was to pump water against a high head; thus, a cubic yard of water falling through 1,000 ft. was capable of giving one H.P.-hour. It would be too expensive to construct a tower 1,000 ft. high. The idea then suggested itself of constructing a large reservoir 1,000 ft. below the ground, and lifting water from this to a second reservoir at ground level. A shaft would be excavated 1,000 ft. deep, and at the bottom of this shaft chambers would be hollowed out and ferro-concreted for the machinery and for the lower reservoir. Estimates were obtained from three different firms of mining engineers in Philadelphia. These showed that a shaft 1,000 ft. deep could be dug, properly timbered, and the necessary chambers hollowed out at the bottom and ferro-concreted so as to withstand the water pressure, at a cost not to exceed 8s. per cb. yd., and tenders were made at that price for a 5,000-H.P. plant. Assuming as before, two weeks' storage and an efficiency of 75 per cent., the capital cost per H.P.-hour would be £7 10s., as against £140 for the storage battery. Assuming interest at 4 per cent. and depreciation at 2 per cent., which latter was a fair value for ferro-concrete work of this character, the total annual cost of the water storage would be approximately 9s., as against £26 in the case of the storage batteries. As regards efficiency, the water storage had an advantage over the storage battery. The energy efficiency of a storage battery was generally given as 65 per cent., *i.e.*, approximately 80 per cent. on charge and 80 per cent. on discharge, the current efficiencies on charge and discharge being slightly over 90 per cent. With the water storage the efficiency of the pumps raising the water might be very high. Pumps lifting 200 ft. might have an efficiency of 97·6 per cent. The efficiency of a water-wheel of the Pelton type working at a pressure equivalent to 1,000 ft. was high, and such turbines were guaranteed with efficiencies of 91 per cent. This would give an energy efficiency for charge and discharge of 85·5 per cent., so that the efficiency which he had taken of 80 per cent. was probably conservative. It was probable that as the system came into extensive use the efficiencies of the turbines would be increased. Tenders for the pumps and Pelton wheels for a 3,000-H.P. plant showed that the cost of this plant was approximately £2 10s. per H.P. Allowing 4 per cent. interest and 4 per cent. depreciation, the total annual cost for pumps and turbines was thus 4s. per H.P. The total annual cost of storing 1 H.P. by the negative gravitational method was, therefore, 4s. + 9s. = 13s., as against £26 for storage by storage battery. It would be noted that this figure of 13s. was a conservative one, and might be much higher without rendering the method commercially impracticable.

Having dealt with the storage which would render the intermittent power obtained from the sun or wind available for use when required, the author proceeded to give the data he had obtained as to the quantity of energy obtainable. He explained that calculations on solar radiation were apt to be misleading, and that the only safe way was to measure for each place the actual amount of radiation received at the earth's surface during the entire time for a number of years. For this purpose he had obtained recorders from the Cambridge Scientific Instrument Co., which were being put to work at different points, and would give most valuable information.

Meantime, in order to obtain the necessary data, a former assistant of his, Prof. Very, whose work in connection with Prof. Langley and whose own researches were well known to all physicists, was kind enough some years ago to investigate the matter. He found that for Central Europe, on an average over a number of entire years, the number of gramme-calories per annum received on a surface of 1 sq. cm. varied between 37,000 and 54,000, the variation being due to the variation in the amount of annual cloudiness. For the Northern United States he found the values to vary between 42,000 and 65,000; while for the arid South-Western States he obtained a value of approximately 100,000.

Reduced to KW.-hours, this gave the following values for the amount of solar energy received on an area 100 metres square per annum at the earth's surface:—Central Europe, 4,000,000 to 6,000,000 KW.-hours; Northern United States, 5,000,000 to 7,500,000 KW.-hours; South-Western United States, 10,000,000 to 15,000,000 KW.-hours. The average was thus only from 4 to 10 per cent. of the *maximum* radiation.

As regards the power from the wind, tests made at the top of a steel tower 420 ft. high at Brant Rock, Massachusetts, in 1905, showed that a windmill 300 ft. in diameter was capable of giving on the average 800 H.P. on the shaft during the entire year. The windmill could be either a single wheel, or could be a number of smaller windmills mounted on a steel frame revolving on a circular track so as always to face the wind. These figures were about 30 per cent. higher than those given by Danish experimenters, due, he thought, to the increase in height. Each individual windmill would be connected by steel ropes to the main driving shaft of the pump. A Pelton wheel would drive the main dynamos, and Prof. Fessenden suggested that a mechanical connection between the windmill and the Pelton wheel shaft would allow power to be used direct when the supply and demand coincided.

To utilise solar radiation a large tank would be employed generating steam at atmospheric pressure which would drive a low-pressure steam turbine. This turbine would operate the pump, which would raise the water from the lower reservoir. A working temperature of 100° C. for the steam was chosen because it enabled more of the heat from the sun to be used, and rendered the construction of the transparent roof of the solar tank more simple, as it was not subjected to an appreciable steam pressure. This roof was of double thickness, and contained wire netting embedded in the glass as a protection against hail. The supports for the glass were of wood, and no special attempt was made to render them tight. The working fluid flowed in a thin stream across the bottom of the solar tank, and the thickness of the stream was varied automatically with the amount of radiation received. The working fluid contained a small amount of bichromate of potash. The glass forming the transparent covering contained a small amount of sulphate of iron, sufficient to give it a pronounced greenish tinge. It had been found that by this means the glass could be made metallically reflecting for wave lengths corresponding approximately to those emitted by the heated water, while remaining fairly transparent to the radiation from the sun. The solar tank was made to have as little specific heat as possible, and, what was more important, to be protected from convection and conduction losses. The thermo-dynamic efficiency of the system was approximately 15 per cent., and it was anticipated that approximately 10 per cent. would be obtainable on the shaft of the steam turbine.

From tenders made the costs per horse-power had been found to be approximately as follows:—Solar tank, £2; low-pressure steam turbine and condenser, £5; dynamo, £3. Adding to this the cost of the pumps and Pelton wheel, the total was £12 10s. for the first cost per horse-power, for the machinery, exclusive of the reservoirs. Allowing interest at 4 per cent. and depreciation at 4 per cent. and 2 per cent for labour, a value of £1 5s. per annum per horse-power was obtained as the cost, exclusive of the reservoirs. Adding the cost per horse-power of the reservoirs, a total of £20 was obtained for first cost and of £1 14s. as the annual cost per horse-power.

It was proposed to combine a solar tank and windmill plant, so that the load would be evened up, *i.e.*, when the sun was shining there was not likely to be so much wind, and in cloudy weather the wind was usually available. This would reduce the storage plant required. A solar tank covering an area of 200 metres square might be expected to receive a total radiation of approximately 20,000,000 KW.-hours per annum. Assuming an efficiency of 10 per cent., 2,000,000 KW.-hours would be obtained on the steam turbine shaft. Assuming a seven-hour day an average of 800 KW. of power would be obtained from the solar radiation plant, and with the energy derivable from the windmill, the total would be approximately 1,500 KW. The total cost of generating and storing this power would be in the neighbourhood of £1 10s. per annum.

The first plant of 3,000 H.P. was to be situated at a copper mine where a vertical shaft was available, and where the worked-out lateral chambers of the mine were available for the lower reservoir. The position of the mine was most suitable, as it was in a district where the average solar radiation was more than twice the value assumed above. Also, the cost of producing the power at the mine with steam engines was considerably higher than the average.

To show the advantage of utilising these intermittent sources of power Prof. Fessenden compared the estimated cost per H.P. per annum with figures here collected for the Ontario Power Commission for other plants of 100,000 H.P.

Method of generating power.	Cost per H.P. per year.
Steam	£4 0 0
Gas engine	3 0 0
Water power at Niagara Falls	0 15 0
From intermittent natural sources	0 18 0
Water power, exceptionally favourable conditions ...	0 10 0

The capital cost per H.P.-annum available when using a solar tank only was approximately £12 10s.; this dropped to £9 when

* We believe this figure is meant to represent the capital cost per horse-power per day of the average user of power.—Eds. Elec. Rev.

windmills were used in connection with the solar tank. These figures compared with the capital cost at Niagara Falls of £8. He thought in England wind power was of more value than solar radiation, and suggested that, where high cliffs were available near the seashore, the water storage could be cheaply arranged. By this means more than sufficient power could be generated to supply all the factories, lighting plants and railways in Great Britain. There would be no difficulty in distributing the power at 5,000 volts from the coast to any part of the kingdom.

Sir William White, in opening the discussion, said that the figures given for any new engineering venture should be received with caution. He had found that such estimates were usually exceeded when one came to carry out the work. He thought that the author would find much valuable information in the Parliamentary reports on the Power Bill.

Mr. R. W. Weekes questioned the availability of solar radiation in Sheffield, and the cost of the underground reservoir.

Prof. Dalby asked if the author considered he could transmit energy obtained from wind power on the English coast to supply the ironworks in Sheffield more cheaply than they now made their energy from coal.

Prof. Fessenden, in reply, said that his figures were conservative ones, and were based on actual tenders received for the various parts of a 3,000-h.p. plant. He was sure that with 500,000 volts, wind power could be delivered in Sheffield at a cost lower than steam power generated on the spot. In reply to a question from Captain Sankey, he said that, with the solar tank he proposed to use, the solar rays would be able to give a maximum output of 30,000 h.p. at times.

Photoelectric Fatigue.

By H. Stanley Allen, M.A., D.Sc.

(*Section A. Abstract.*)

The observation of Hertz, in 1887, that the electric spark passes more readily when the spark gap is illuminated by ultra-violet light led to the discovery by Hallwachs of the photoelectric current. A negatively charged body often loses its charge rapidly when exposed to light, especially to ultra-violet light. The discharge is due to the emission of negative electrons from the illuminated surface. The photoelectric activity of a freshly polished metal surface diminishes with the time, falling off rapidly at first, more slowly later on. This is known as the "fatigue" of the Hallwachs effect. In the early literature of the subject the fatigue was attributed to the direct action of the light, but Hallwachs showed in 1904 that fatigue proceeds in complete darkness, so that light cannot be the primary cause of the change. At ordinary pressures fatigue is more rapid in a large vessel than in a small one. The fatigue is practically independent of the electrical condition of the plate.

Experiments in a vacuum have led to contradictory results. Recent experiments by Millikan and Winchester show no fatigue with clean unpolished metal surfaces in a very high vacuum.

Hallwachs has shown from the photoelectric behaviour of copper and its oxides that oxidation cannot be the cause of fatigue, and the fact that fatigue is less in a small vessel may be interpreted by attributing it to some substance (*e.g.*, ozone, water vapour) present in small quantities in the surrounding atmosphere. The results recorded lead to the view that the main cause of fatigue is to be found in the condition of the gaseous layer at the surface of the plate.

The Mechanical Hysteresis of Rubber.

By Prof. Alfred Schwartz.

(*Section G. Abstract.*)

The increasing importance of the applications of rubber in the Arts calls for carefully standardised tests of the properties of this material.

The physical properties of rubber of which use is made in industrial work are its elasticity, compressibility, extensibility, tenacity, flexibility, adhesiveness, resistance to certain chemical agents, impermeability to water, solubility in certain liquids, and electrical resistance and dielectric strength.

The methods of testing employed at the present time consist in chemical analysis and in the determination of the elongation and load at rupture and of the sub-permanent set resulting from a given extension maintained for a given time.

It is evident that the chemical tests can give no indication with regard to many of the physical properties enumerated above, and it would seem that their true function lies in the determination of *causes*, while the mechanical tests should deal with the *effects* produced by these causes in the commercial product.

The mechanical tests should then form the primary tests of both the manufacturer and the purchaser, and should, when necessary, be supplemented by the chemical tests, either as confirmatory tests or for the elucidation of the causes of the defects indicated by the mechanical tests. In the case of raw rubbers the chemical tests give little or no indication of the value of the product for industrial purposes, and it is suggested that test pieces for such materials should be prepared from the so-called "Admiralty mixing," consisting of 60 per cent. rubber, 3 per cent. sulphur, and 37 per cent. zinc oxide, and be subjected to the hysteresis tests hereinafter described.

The author has designed a machine in which a specimen of rubber of standard dimensions is loaded at a given rate to a given percentage of its breaking load. The load is then removed at the same rate, and a graphical record is obtained on the chart table of the machine of the extension and retraction curves.

Rubber possesses very considerable mechanical hysteresis, and a consideration of the loop diagram obtained from the machine enables the following physical quantities to be determined for any given test piece :—

1. The rate of extension with load.
2. The work done in extension.
3. The work done by the rubber in retracting.
4. The work expended in the rubber itself.
5. The sub-permanent set remaining after a given extension.

The limits of the hysteresis loop may also be set in terms of extension in place of load as already stated. The author finds that for a given rubber the following laws hold good :—

(*a*) The load per unit area of the initial cross-sectional area of the test piece is constant for a given extension of the test piece and independent of the cross-sectional area of the specimen within certain limits.

(*b*) The work done in extension, in retraction, and in the rubber itself, is within certain limits proportional to the cross-sectional area of the test piece, and is directly proportional to the length of the specimen with a given percentage extension.

On the completion of the first cycle of extension and retraction the specimen may be subjected to a series of similar cycles, the limits of which may be set either by a given maximum extension or a given maximum load.

For high-grade rubbers the areas of the loops for successive cycles become constant after about the sixth loop, when the subsequent cycle loops are taken up to the same maximum load as that for the first loop.

The author finds that the extension for a given load limit increases with each successive cycle, and that the rate of increase follows a logarithmic law from the second cycle onwards.

Applications of the hysteresis test are given to the determination of various grades of rubber, of the quantity of rubber in a given mixing, of the degree of vulcanisation, and of the deterioration due to age or high temperature.

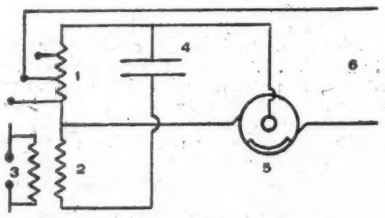
A New Method for Producing High-Tension Discharges.

By Prof. Ernest Wilson and W. H. Wilson.

(*Section G. Abstract.*)

Referring to the diagram of connections, energy is (according to this method) stored in a magnetic field by an inductance 1 ; it is then permitted to surge into a condenser 4, which forms with the inductance 1 a low-frequency oscillatory circuit. When the energy is accumulated in the condenser 4, the latter is mechanically bridged across the primary winding 2 of an induction coil with which it forms a high-frequency oscillatory circuit. The energy is then transmitted by the secondary winding 3 of the induction coil to the work circuit, and can be of an oscillatory or uni-directional character according to the purpose in view. The above cycle of events is controlled by a contact maker 5 which is driven by a small motor arranged with commutator and slip rings so that the apparatus can be worked when the supply mains 6 are either D.C. or A.C. Tapping points on the inductance 1 allow of a suitable range of voltages being used.

Going a little further into detail one may say that at "make" the system is switched on to the supply mains, the current rises in the winding of the inductance 1, and builds up the magnetic field. When sufficient energy has been stored the system is severed from the mains, and this may be referred to as the epoch of "break." As only the current in the condenser 4 passes through the primary winding 2 the inverse electromotive force induced in the secondary winding 3 is so small as to be negligible, but if desired it can be entirely eliminated by a modification in the connections. At the



Connections of Wilson System.

epoch of "break" the energy stored in the condenser 4 is added to that in the inductance 1, and then the total energy in the inductance 1 begins to surge into the condenser. At the precise epoch when the condenser has received the whole of the energy in virtue of its reverse charge, the contact maker 5 short circuits the inductance 1. The condenser then discharges with great rapidity through the primary winding 2, and the energy then oscillates between the condenser and primary winding in the well-known manner. As is also well known, the electromotive force induced in the secondary winding 3 may be of an oscillatory or uni-directional character according to the nature of the work circuit.

Briefly, the following are some of the advantages gained :—

1. For X-ray work the inverse electromotive force is eliminated, thereby leading to increased life of the tube and to a more sharply-defined radiogram.

2. Only a small magnetising current is required, as the inductance l has nearly a closed magnetic circuit. This gives rise to very small C^2R loss, and consequently higher efficiency.

3. On account of the long periodic time of the system, the voltage across the contact of the interrupter 5 at "break" does not rise to a high value, or rises so slowly that the contacts are well separated before it is developed. No oil or coal gas is required.

4. The method lends itself to a few secondary turns, and this keeps down the time-constant. It also makes the coil lighter, cheaper and more compact.

5. The method lends itself to low secondary resistance, a point of great importance in wireless telegraphy.

6. The iron in the spark coil can be kept small in amount, and special attention can be paid to its lamination and insulation, as it may have to be operated at frequencies of some thousands per second.

7. The elimination of sparking increases efficiency, and on board ship, where coal gas is not conveniently obtained, this is an advantage.

8. The apparatus is light, portable, reliable and cheap.

9. The apparatus can be worked from D.C. or A.C. systems at usual voltages, or from a portable battery of a few storage cells.

10. The oscillating current at "break" does not pass through the battery, and hence does not assist in its discharge.

11. The iron in the magnetic circuit of the external inductance l has only to operate at low frequency, and hence it has not to be finely laminated.

BRAKE SHOES.

THE Master Car-Builders' Association (U.S.A.) maintains a standing Committee for brake-shoe testing, and it is as a result of the work of this Committee that the steam railroads, and, to a very large extent, the electric tramroads of the country, have long reached the ideal of standardised brake parts.

Of late the Committee has turned its attention to the wear of the standard brake-shoes, and, arising out of that, to the wear of wheels under braking. We print an abstract of the Report which was presented to the recent Convention in Atlantic City, and we think that our readers will be surprised at the outcome of the tests. It is possible that our own steam railway engineers have discovered long ago the peculiar immunity of the carriage wheels from wear due to brake action, but we have not heard of it, and we shall credit the M.C.-B. Association with demonstrating the unsuspected, and, indeed, the unlikely fact that "no serious wear of the wheel (whether of cast-iron or steel) is to be expected from the action of the shoes now in ordinary service."

The series of tests from which this conclusion was drawn was conducted under laboratory conditions, to which steam railroad conditions approximate fairly closely; but the question for us, who are interested more particularly in tramways, is to what extent these test results may be applied to electric street tramways.

The *Electric Railway Journal* considers that the general conclusions of the Committee can be used successfully for the formulation of specifications for electric car brake-shoes, for although the rail conditions are worse in towns than upon railways, the action of the shoe upon the wheel is nearly identical. That is the point about which we are not at all clear, for it seems obvious, and it has become an axiom, that the grit from street surfaces and sand-boxes must grind away the wheel tread when pressed into it by the brake-block. Could not our Brake Committees carry out tests which would supplement the excellent work of the M.C.-B. Association?

During the year the Committee made use of a new scale designed to weigh car wheels before and after braking tests in order to determine the wear on the wheel caused by the brake shoe.

Fourteen shoes submitted to the laboratory at Purdue University were tested to determine the wear under repeated applications to both cast-iron and steel-tired wheels. The shoe wear and wheel wear tests were run under the following conditions:—

(*a*) On the cast-iron wheel.—At a constant speed at 20 M.P.H. and at a shoe pressure of 2,808 lb.

(*b*) On the steel wheel.—At a constant speed of 20 M.P.H. and at a shoe pressure of 2,808 lb.

(*c*) On the steel wheel.—In effecting stops from an initial speed of 65 M.P.H. and at a shoe pressure of 12,000 lb.

During the tests at the lower pressure most of the shoes were applied 300 times to the wheel. These applications were made by means of an automatic device which operates to keep the shoe in contact with the wheel for about one minute, while the interval between contacts is about three minutes.

The tests on the steel wheel at the higher pressure (condition *c*) were made by a process similar to that employed in determining the coefficient of friction. In most cases, nine stops were made from an initial speed of 65 M.P.H., after which both the shoe and the wheel were weighed to determine their loss.

The only shoe which produced an appreciable wear on the cast-iron wheel was an insert shoe. It is somewhat significant that this shoe showed the least shoe wear. During the tests on the steel wheel, only two shoes caused any considerable wear of the wheel. These were both insert shoes. During the tests on the steel wheel at a pressure of 12,000 lb., only two shoes produced any wear whatever on the wheel, and this was quite inconsiderable in amount. These were both composition shoes; they, however, did not score the wheel.

After consideration of all the facts, the Committee has concluded that no serious wear of the wheel is to be expected from the action of any of the shoes now in ordinary service, and it, therefore, considers any recommendation concerning wheel wear to be unnecessary.

The Committee recommends concerning shoe wear that on the cast-iron wheel the shoe wear be determined by making 100 applications of the shoe to the wheel, under a pressure of 2,808 lb., and at a constant wheel speed of 20 M.P.H.; at each application the shoe to be in contact with the wheel during 190 revolutions and out of contact during the succeeding 610 revolutions. That, under these conditions, the shoe shall lose in weight not more than 0·8 lb. for each 100,000,000 ft.-lb. of work done. That, on the steel-tired wheel the shoe wear be determined by making 10 stops from an initial speed of 65 M.P.H., and under a shoe pressure of 12,000 lb. That, under these conditions, the shoe shall lose in weight not more than 4 lb. for each 100,000,000 ft.-lb. of work done.

The Committee believes that inserts should be made as thick as the processes of manufacture will permit, and it recommends that in no case should the thickness of the insert in a new shoe be less than one-half of the total depth of the shoe.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

ST. KITTS-NEVIS.—The following are admitted free of duty: Steam engines and steam-pipes, boilers and boiler tubes, fire-bars and machinery whether stationary or portable for agriculture, irrigation or mining, and all necessary parts and appliances for the erection or repair thereof or for the communication of motive power thereto when not imported for sale.

Electrical goods in general ... ... 11 % ad val.

The value of goods liable to *ad valorem* duty is taken to be the original invoice value exclusive of shipping charges, cost of cases, bales, &c., and also of discount.

N.B.—No person may import or establish any apparatus or installation within the Presidency for the purpose of, or in connection with, wireless telegraphy without a licence from the Governor.

ST. HELENA.—All kinds of electrical goods, free.

ST. LUCIA.—The following goods are admitted free of duty: Belting for machinery of leather, canvas or india-rubber; locomotives, railway rolling stock, rails, railway ties and all materials to be used exclusively for the construction, equipment and operation of railways and tramways; professional apparatus and workmen's tools brought in by passengers for their own use; steam and power engines and machines, machinery and apparatus whether stationary or portable worked by power or by hand, for agriculture, irrigation, mining, the arts and industries of all kinds and all necessary parts and appliances for the erection or repair thereof or the communication of power thereto; steam boilers and steam pipes; telegraph wire, telegraphic, telephonic and electrical apparatus and appliances of all kinds for communication or illumination; all articles imported for the use of the Castries Town Board.

Goods not separately mentioned in the Tariff pay a duty of 15 per cent. *ad valorem*; the value of goods for assessment of duty being the invoice price exclusive of freight, insurance and other charges.

N.B.—No person may establish, erect, maintain or use in the Colony any apparatus or installation for the purposes of wireless telegraphy without a licence from the Governor.

ST. VINCENT.—The following goods are admitted free of duty; All articles imported for the Public Service of the Government provided that the same be certified by the Colonial Secretary to be for such service; coal; machinery driven by steam or other power or by hand which the Governor-in-Council may consider to be useful for the development of local manufacture or products or to be imported for the development or improvement of any business or manufacture carried on or belonging to the importer; telegraph wire, telegraphic, telephonic and electrical apparatus and appliances of all kinds for communication or illumination, including all materials for the use of the West India and Panama Telegraph Co.

Goods not specially mentioned in the Tariff pay a duty of 10 per cent. *ad valorem* calculated on the cost price of the goods in the country of origin exclusive of freight and other charges.

N.B.—No person may erect, install, maintain or use any apparatus or instrument for the purpose of wireless telegraphy without a licence from the Governor.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

20,624. "New process for the manufacture of earthenware insulators." D. G. Norman. September 5th.

20,647. "Improvements in or in connection with the flexible conductors and fittings for electric light pendants and for portable electrical apparatus." S. K. Thompson. September 5th. (Complete.)

20,651. "Improvements in or relating to electric cable conduits." H. D. Carter. September 5th.

20,661. "Improvements in vacuum tube lighting apparatus." F. J. Brougham. (Moore Electrical Co., United States.) September 5th. (Complete.)

20,685. "Improved means of controlling the connection and disconnection of a plurality of electrical circuits to or from another such circuit." J. Sutton and G. J. Sutton. September 5th.

20,696. "New or improved electrical alarm device." A. Girardella and P. Holzman. September 5th.

20,749. "Improved method of plating steel, brass and the like." A. P. Bishop and M. Pavero. September 6th.

20,750. "Improvements in electrical lifts and apparatus therefor." F. Hodgson. September 6th.

20,754. "Improvements in the electro-deposition of iron." S. O. Cowper-Coles. September 6th.

20,759. "Apparatus for varying the mean potential of starting machines (distributing dynamo machines)." Allgemeine Elektricitats Ges. (Date applied for under Sec. 91 of the Act, September 6th, 1909, being date of application in Germany.) September 6th. (Complete.)

20,760. "Process and electrical medical apparatus." L. Moliere. (Date applied for under Sec. 91 of the Act, September 6th, 1909, being date of application in Belgium.) September 6th. (Complete.)

20,776. "Improved process and apparatus for electro-deposition." S. Consigliere. (Date applied for under Sec. 91 of the Act, September 7th, 1909, being date of application in Italy.) September 6th. (Complete.)

20,783. "Improvements in electric current converters." J. S. Goodwin, J. A. Jones Haslop and T. H. Brown. September 6th.

20,790. "Improvements in flexible electric wires or cables." S. C. Caddy. September 6th.

20,802. "Improvements in systems or methods and apparatus for controlling electrical apparatus, conductors and the like." W. S. Burge. September 6th.

20,818. "New or improved method of and apparatus for controlling electric lighting and power circuits." A. Barry. September 7th.

20,827. "Improved vibration absorbing attachment for electric lamp-holders." H. Bailey. September 7th.

20,828. "Improved means for insulating the covers, boxes and cases of electric switches, cut-outs, and the like apparatus." M. J. Railing and A. J. D. Krause. September 7th.

20,833. "Improvements in or relating to the transmission of telephone messages." G. B. Wallis. September 7th.

20,861. "Improvements in trolley heads employed in electrical traction." T. M. Watson. September 7th.

20,863. "Improved circuit-breaking apparatus for use in producing ignition in explosion motors." Societe Electricite "Nilmelior." (Date applied for under Sec. 91 of the Act, March 2nd, 1910, being date of application in France.) September 7th. (Complete.)

20,872. "Improved interrupter particularly applicable for use with induction coils." R. S. Wright. (Veifa-Werke Vereinigte Elektrotechnische Institute Frankfurt-Aschaffenburg, m.b.H., Germany.) September 7th. (Complete.)

20,882. "Improvements relating to electromagnetic devices for controlling electric switches or the like." British Thomson-Houston Co., Ltd., and E. B. Wedmore. September 7th.

20,900. "Improvements in electrical switches." J. H. Tucker. September 8th.

20,906. "Method of and means for discharging electric accumulators of secondary batteries." A. M. Taylor. September 8th.

20,911. "Spring grip electric lampholder." F. A. Martin and A. Crossley. September 8th.

20,913. "Device to prevent damage through concussion to filaments in lamps as applied to electric lighting." J. M. Evans and J. H. Harris Harris. September 8th.

20,917. "Improvements in electric railways." J. H. Mawson. September 8th.

20,948. "Improvements in rotary transformers for converting alternating into direct current." L. R. Auvert and A. F. E. Ferrand. September 8th. (Complete.)

20,957. "Improvements in and relating to automatic governors or electric regulating devices." Societe Anonyme Ateliers. (Date applied for under Sec. 91 of the Act, September 13th, 1909, being date of application in Switzerland.) September 8th. (Complete.)

20,968. "Improvements in the electric ignition for internal combustion engines." Firm R. Bosch. (Date applied for under Sec. 91 of the Act, November 1st, 1909, being date of application in Germany.) September 8th. (Complete.)

20,994. "New or improved internal combustion turbine engine." J. Lewthwaite September 8th.

20,995. "Improvements relating to distribution panels and the like for use in connection with electric cranes, and for analogous purposes." Electric and Ordnance Accessories Co., Ltd., and M. R. H. Mueller. September 8th.

21,024. "Automatic gas mixer for use in internal combustion engines." P. Valvero and J. Sivers. September 9th. (Complete.)

21,031. "Improvements in or relating to magnetic separators." M. Ruthenburg. September 9th. (Complete.)

21,041. "Improvements relating to electric voltage regulation." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) September 9th.

21,045. "Improvements in or relating to magnetic separators." G. T. Meek. September 9th.

21,102. "Improvements in electric terminals or connectors." W. W. Genn. September 10th.

21,120. "Circuits for telephone exchanges." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) (Complete.)

An Australian Electrical Institute.—The *Australian Mining Standard* states that the Victoria Institute of Electrical Engineers has now over 100 members, and a banquet has been arranged to celebrate the event. Dr. Graham Bell, of telephone fame, now in Melbourne on a visit, is to be present.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

Electric Switches. B. Thomas and E. Thomas. 15,681. July 6th.

Circuit Breakers for Electric Welders and the like. S. Jevons and V. O. Green. 18,036. August 5th.

Electric Furnaces for the Continuous Manufacture of Glass. M. Sauvageon. 18,118. August 5th.

Contacts for Electric Switches and the like. M. B. Field and Ferranti, Ltd. 18,221. August 6th.

Electric Time-Indicators. F. Hope-Jones. 18,405. August 10th.

Magnetic Separators. A. P. Hutchinson. 18,420. August 10th.

Wireless Telephony. V. Colin and M. Jeance. 18,486. August 10th. (Date applied for under International Convention, April 17th, 1909.)

Transmitting Apparatus for Wireless Telegraphy. G. Marconi and Marconi's Wireless Telegraph Co. 18,524. August 11th.

Means for Preserving or Protecting the Lead Supports of the Positive Electrodes of Secondary or Storage Batteries from Per-oxidation. P. Maring. 18,590. August 12th.

Switch for Controlling Electrical Circuits. T. J. Rorke and E. Rorke. 18,687. August 13th.

Electrical or Electrically Operated Fire-Alarms. W. Leake and A. V. Rushworth. 18,771. August 14th.

Transmitting Apparatus for Wireless Telegraphy. G. Marconi and Marconi's Wireless Telegraph Co. 20,229. September 3rd.

Electric Switches and Switch Fuses. H. H. Berry and W. J. Markham. 21,185. September 16th.

Audible Electric Signalling Devices and the like. T. S. Rogers. 23,802. October 18th.

Appliances or Means for Mounting Incandescent Electric Lamps. A. W. Beuttell. 24,950. October 29th.

Arrangements for Electrically Reproducing a Movement at a Distance. Harle et Cie. 28,164. December 2nd. (Date applied for under International Convention, December 7th, 1908.)

Electrically Operated Ammunition Hoists or Gun-Loading Systems. Otis Elevator Co. (Otis Elevator Co.) 29,129. December 14th.

Speed-Governing Devices for Electrically Driven Shafts. M. Olmsted, 30,187. December 24th. (Date applied for under International Convention, January 9th, 1909.)

High-Tension Magneto-Electric Machines. F. R. Simms and Simms Magneto Co., formerly Simms Manufacturing Co. 15,380. July 1st.

Electricity Meters. W. H. Johnson and A. M. Billington. 16,332. July 13th.

Automatic Switchgear for the Remote Control of Electric Motors. M. T. Medway and M. D. Scott. 18,675. August 13th.

Electric Battery Lamps. F. J. Turquand and W. A. Turquand. 18,756. August 14th.

Electrical Devices for Controlling Movements from a Distance, and Methods of Mounting the same. P. Viry. 18,847. August 16th. (Application for Patent of Addition to No. 18,624 of 1909.)

Filament or Resister for Heating Units or Lamps. H. W. Lake. (Parker-Clark Electric Co.) 18,954. August 17th.

Means for Rectifying Electric Currents. R. Murphy. 19,090. August 19th.

Coin-Freed Apparatus for Supplying or Measuring a Current of Electricity. J. A. Farrand. 19,660. August 27th.

Metal Conduit Tube Couplings or Junction Articles or Boxes of Electric Cables. R. Butler and M. A. Gibbings. 20,067. September 1st.

Method of Taking Photographs with Rontgen Rays. F. Dessauer. 23,455. October 13th.

Construction of Electric Lamp Holder. H. E. Sheward. 26,048. November 10th.

Telephone Transmitters. K. O. Leon and C. C. Lewis. 26,779. November 18th.

Boxes for Containing Mantles used in Incandescent Gas Lighting, Incandescent Electric Lamps, and other Fragile Articles. A. H. Stevenson. 26,873. November 19th.

Electric Switch with Lever Motion and Instantaneous Make and Break. J. B. Wynne. 28,429. December 6th.

Electric Bell-Pushes. H. Hirst and S. O. White. 28,557. December 7th.

Electric Arc Lamps. H. Hirst and A. E. Angold. 29,068. December 13th.

1910.

Apparatus for Electrical Ignition in Internal-Combustion Engines. Firm of Robert Bosch. 13,899. June 8th. (Date applied for under International Convention, August 18th, 1909.)

Method of Constructing Magneto-Electric Ignition Machines for Internal-Combustion Engines. Firm of Robert Bosch. 14,575. June 16th. (Date applied for under International Convention, July 19th, 1909.)

Electrodes for Arc Lamps. F. M. Lewis. 15,977. July 4th. (Date applied for under Rule 13, August 10th, 1909.)

Means for Checking the Use of Electric Lighting Apparatus, and more particularly of Electric Glow Lamps. Felten & Guilleaume Lahmeyerwerke Akt.-Ges. 2,432. January 31st. (Date applied for under International Convention, February 1st, 1909.)

Current Motors. R. Martin. 2,894. February 5th.

Prepayment Electricity Meters. W. S. Sprague and Chamberlain & Hookham, Ltd. 3,250. February 10th.

Protective Devices for Electrical Transmission and Distribution Systems. British Thomson-Houston Co. and E. B. Wedmore. 6,668. March 16th. (Date applied for under Rule 13, October 18th, 1909.)

Ventilation of Continuous-Current Dynamo-Electric Machines. Siemens Bros. Dynamo Works, Ltd., and Parker. 8,409. April 7th.

Means for Protecting Tubes and Vessels from Galvanic or Electric Currents. C. Politz. 9,094. April 14th. (Date applied for under International Convention, April 22nd, 1909.)

Electric Conduit Threaders. G. A. Brown, D. R. Gatenby, E. Gourlay and M. Gourlay. 10,705. April 30th.

Telephone Exchange Circuits. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 11,251. May 6th.

Arrangements for Preventing Remanent Magnetism in Dynamo-Electric Machines. Siemens Bros. Dynamo Works. (Siemens-Schuckertwerke Ges.) 14,153. June 11th.

Arrangements for Obtaining a Braking Action in Polyphase Commutator Electric Motors. Siemens Bros. Dynamo Works. (Siemens-Schuckertwerke Ges.) 14,359. June 14th.

Sparking Devices for Internal-Combustion Motors. L. Dutheil and R. Chalmers et Cie. 1,120. January 15th. (Date applied for under International Convention, January 15th, 1909.)

Electric Valves. T. J. Murphy. 3,410. February 11th. (Date applied for under Rule 13, August 19th, 1909.)